TECHNICAL
PUBLICATION

NATIONAL PHOTOGRAPHIC
INTERPRETATION CENTER

A GLOSSARY FOR COLOR AERIAL RECONNAISSANCE

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1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

This glossary attempts to define and describe in simple, understandable language a set of words, concepts, and measures related to color aerial reconnaissance. The purpose of the glossary is to provide a reference which can be used to learn and understand basic terminology related to color aerial reconnaissance and to help improve communication concerning color. For maximum usefulness several criteria were used to guide and limit the compilation and writing of the glossary:

1. The words chosen and their definitions should be relevant to color as it relates to aerial reconnaissance. Since aerial reconnaissance is broad, the Glossary is broad, covering terminology from color aerial photography (its acquisition, processing, and interpretation), and from the psychology, physiology, physics, and measurement of color. Yet within these broad categories there are gaps in terminology which are not related to aerial reconnaissance. Thus the reader should not expect to find a complete and comprehensive glossary on Color.

2. The language (terms and concepts) of the glossary should be easy to understand so that a wide range of personnel in aerial reconnaissance could read and understand the material included. For those who wish or need to know greater technical detail, theory, or procedures there are a number of excellent references in all technical areas.

3. Extraneous words and concepts should be omitted so that the material can be presented in a succinct manner.

To help satisfy these criteria, a review of the major literature in aerial reconnaissance and in related technical fields was performed and major sources, e.g., technical textbooks, manuals, glossaries, and dictionaries were selected for use. These sources were then searched for relevant words, concepts, and measures, resulting in over 1,000 terms to be included. Each term had at least two or three definitions, so the most appropriate one had to be chosen. Then, if necessary, it had to be

rewritten in order to adhere to the prescribed format (discussed below). In addition, figures, tables, and added explanations in the form of "Notes", were used to help clarify the definitions and aid in reader understanding.

1.2 FORMAT

Important aspects of the Format are enumerated below:

(1) The terms are arranged in alphabetical order and are capitalized. Following certain terms one or more synonyms will appear in parentheses. Reference numbers in brackets also will be used if the definition has been taken from the source, either verbatim or slightly modified.

(2) Under each term is the definition, and if more than one definition is used, they are enumerated. Within a definition, important words, if also defined in the glossary, are capitalized.

(3) Following the definition(s) there may be a "Note" which is used for additional explanation and illustration.

(4) Finally, a "See Also" is used when the reader should refer to another glossary word for further explanation.

All major figures and tables are found in the Appendix and a general reference list is included which contains the major sources for the glossary.

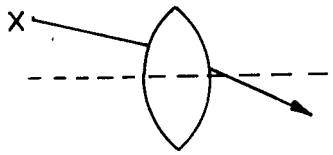
2.0 GLOSSARY

A

ABAXIAL [4]

A ray of light that does not coincide with the OPTICAL AXIS. A marginal ray passing through a lens.

Note: See Figure below, light ray x is ABAXIAL.



ABBE NUMBER [8]

The number expressing the extent to which the shorter and longer wavelengths of light are separated by refraction through a particular glass, i.e., the amount the glass disperses the various colors. The greater the number, the smaller the dispersion, i.e., the less the separation of the colors after refraction. In practice they vary from about 25.5 for Double Extra Dense Flint glass to 60.3 for Hard Crown glass.

Note: The Abbe Number is $(\eta_D-1)/(\eta_F-\eta_C)$ where η is refractive index and the subscripts indicate measurement at the sodium D line (589 nm), the hydrogen F line (486 nm), and the hydrogen C line (656 nm).

ABERRATION [12]

The failure of an optical system to bring all light rays received from a point object to a single image.

Note: Defects in the performance of a lens or mirror which prevent it from giving an absolutely sharp image. In practice the complete removal of all aberrations is impossible. The aberrations inherent in any optical system are listed below.

See Also: CHROMATIC ABERRATION; SPHERICAL ABERRATION; COMA; CURVATURE OF FIELD; ASTIGMATISM; and DISTORTION

ABNEY EFFECT

The change in apparent HUE which may occur when SATURATION is changed.

ABRIDGED SPECTROPHOTOMETRY

A compromise to true SPECTRO-PHOTOMETRY in which a set (often 10-16) of narrow-bandpass filters (5-20-nm half width) is used to provide an approximation to the complete spectrophotometric curve.

ABSOLUTE TEMPERATURE [4]

A temperature with the Kelvin (K) scale, having degrees the same size as Celsius (Centigrade) and zero placed at approximately -273 C. Thus 0 C. = 273 K. 100 C.= 373 K.

ABSORBANCE, SPECTRAL

Absorbance at a specified wavelength.

ABSORBANCE [5] (ABSORPTION FACTOR)

Logarithm (to the base 10) of the ratio of the light (LUMINOUS FLUX) incident on a transparent body, to that emerging from it. Preferred to DENSITY or OPTICAL DENSITY.

ABSORBED LIGHT

Light which is converted into heat when passing through a body.

ABSORPTION (SELECTIVE ABSORPTION)

The dissipation of light into heat when passing through a medium. The remaining light is either TRANSMITTED or REFLECTED.

Note: Color of objects is the result of selective absorption of certain wavelengths. If white light falls on a surface that absorbs the red and green rays, the surface appears blue to the eye because that is the only visible light reflected by the surface. If white light passes through a transparency that absorbs all wavelengths but red, the transparency will be perceived as red.

ABSORPTION BAND (ABSORPTION LINE) [4]

The dark band or line in the spectrum or SPECTROGRAM caused by the failure of the material that is being analyzed to transmit light of that wavelength.

Note: For example, a yellow filter will not transmit a certain portion of wavelengths in the blue region. The SPECTROGRAM of the yellow filter would show dark lines at those wavelengths.

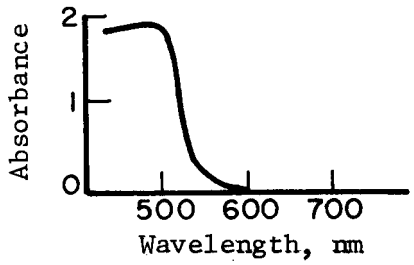
ABSORPTION COEFFICIENT

See ATTENUATION COEFFICIENT

ABSORPTION CURVE [8]

Graphic representation of the ABSORBANCE of a medium, plotted against the wavelength of the light. Generally used to give an indication of the characteristics of color filters and dyes in color films.

Note: The Figure below is an Absorption Curve for a yellow filter (minus-blue filter).



ABSORPTION FACTOR

See ABSORBANCE

ACCELERATOR

A term often applied to the alkaline constituent of a developing solution because increasing the amount of alkali in all normal cases speeds up the action of a developer.

ACCOMODATION

(1) The faculty of the human eye (lens) to adjust (focus) in order to render sharp images for different object distances (4 to 5 inches to infinity).

(2) The ability of the eyes to bring two images into superimposition for stereoscopic viewing.

ACHROMATIC

(1) Lacking in HUE and SATURATION, and varying only in BRIGHTNESS, or LIGHTNESS, e.g., black, white, or any gray.

(2) When applied to a lens, it means that the lens has been corrected for CHROMATIC ABERRATION at two wavelengths.

See Also: ACHROMATIC LENS

ACHROMATIC COLOR [5]

Color perceived to have no HUE.

Note: Examples of Achromatic Color are black, gray, white, and "clear, colorless".

ACHROMATIC LENS (ACHROMAT) [4]

A lens that is corrected for chromatic aberration at two wavelengths of light. A lens that is customarily made to bring green and red light rays to approximately the same point focus.

Note: Such a lens is not sufficiently corrected for color photography, ADDITIVE COLOR SEPARATIONS, or COLOR SEPARATION NEGATIVES

See Also: APOCHROMATIC LENS

ACHROMATIC LIGHT [5]

Light perceived as having no HUE.

ACHROMATIC OBJECT [11]

An object that reflects or transmits the same proportion of light at each wavelength. Thus, appearing ACHROMATIC, e.g., black, white, or grays.

ACHROMATIC POINT [5]

Point in the CHROMATICITY DIAGRAM in the CIE color system used as the basis for determination of DOMINANT and COMPLEMENTARY WAVELENGTHS and for EXCITATION PURITY because it represents the CHROMATICITY of a color which is acceptable as achromatic under the conditions in which the colors are observed. Usually, the chromaticity of the illuminant is used for this point.

ACHROMATIC POINT [5] (Continued)

Note: See Figure 2 in the Appendix. The center of the circle denoted as "WHITE" is the Achromatic Point.

ACHROMATIC REGION [5]

The part of a CHROMATICITY DIAGRAM in the CIE Color System that represents ACHROMATIC COLORS under circumstances of common occurrence.

Note: See Figure 2 in the Appendix. The area inside the circle denoted as "WHITE" is the Achromatic Region.

ACHROMATOPIA (ACHROMATOPSIA, ACHROMATISM) [5]

Type of MONOCHROMATISM in which all colors are perceived as achromatic or total color blindness.

ACTINIC LIGHT [4]

A part of the spectrum (usually infrared, visible, and ultraviolet wavelengths) that causes chemical changes to occur in light sensitive photographic emulsions. The light that creates images on light sensitive material. The blue or violet portion of the spectrum would be the actinic band of light for blue or violet sensitive photographic materials.

ACTINOMETER [4]

An instrument for measuring the ACTINIC value of light according to a given scale.

See Also: ACTINIC LIGHT

ACUITY, VISUAL [4]

A measure of the eye's ability to separate details in viewing an object. The reciprocal of the minimum angular separation, in minutes of arc, of two lines of detail which can be seen separately.

See Also: LINE PAIR

ACUTANCE [4]

A complex, objective measure of the ability of a photographic system to show a sharp edge between continuous (touching) areas of low and high.
The degree of sharpness and contrast of edges in an image.

ADAPTATION

The faculty of the human eye to adjust its sensitivity to varying intensities and colors of illumination.

See Also: ADAPTATION, DARK; ADAPTATION, LIGHT; AND ADAPTATION, CHROMATIC

ADAPTATION, CHROMATIC

The faculty of the human eye to adjust its sensitivity to differences in HUE and SATURATION, or colors.

Note: When staring at a single color, the eye adapts to it; but upon looking at another color, the eye must adapt again before the color will be perceived optimally.

ADAPTATION, CHROMATIC (Continued)

However, this adaptation occurs relatively quickly.

See Also: AFTER-IMAGE

ADAPTATION, DARK

The faculty of the human eye to increase its sensitivity to reduced illumination.

Note: In total darkness, dark adaptation takes 30 to 45 minutes, although in 15 minutes sensitivity has increased significantly.

See Also: SCOTOPIC VISION

ADAPTATION, LIGHT

The faculty of the human eye to lower its sensitivity to increased illumination.

Note: Light adaptation occurs in a few minutes.

See Also: PHOTOPIC VISION

ADDITIVE COLOR MATCHING

A COLOR MATCHING procedure in which the standard is varied by adding various proportions of different colors.

See Also: THREE-COLOR MIXTURE; NEGATIVE COMPONENT IN COLOR MIXTURE

ADDITIVE COLOR PRINCIPLE

The principle that most colors can be formed by mixing the lights of two or more other colors.

See Also: ADDITIVE SYNTHESIS

ADDITIVE COLOR SEPARATIONS

A method for reproducing all colors using the principle of ADDITIVE SYNTHESIS. Usually, black-and-white positive transparencies are acquired through the primary color filters (blue, green, and red), and are projected and viewed in register by means of light beams of the same primary colors.

See Also: ADDITIVE SYNTHESIS

ADDITIVE SYNTHESIS (ADDITIVE COLOR MIXTURE) [5]

The formation of a color by mixing light of two or more other colors. Most colors may be formed by mixing light of three conveniently selected primary colors (blue, green, and red) in the proper proportions. Some colors may be formed by mixing light of two colors.

Note: For example, a mixture of blue and green lights produces CYAN, a mixture of blue and red lights produces MAGENTA, and a mixture of green and red lights produces YELLOW.

See Also: NEGATIVE COMPONENT IN COLOR MIXTURE

ADJACENCY EFFECTS

When two adjacent areas of an image receive exposures of different magnitude, their respective densities and the position of their common boundary may not reflect the exact distribution of light within the emulsion at the time of exposure. The results are known as Adjacency Effects. In color materials, during processing, the DEVELOPMENT products may diffuse away from the silver halide grains and react with the DYE COUPLER to form a dye image at some distance from the silver image. The secondary dye image improves edge definition, but also produces objectionable halos. Color fringing may also occur as a result of unequal effects in the several dye layers.

ADVANCING COLORS [5]

There are WARM COLORS (typically reds) which are perceived, or tend to be perceived, leaving the picture plane or physical plane and approaching nearer to the observer.

Note: When viewing color transparencies or prints, the objects imaged as "warm colors" may appear to stand out from the image. During stereo viewing this may cause exaggerated heights.

AERIAL EXPOSURE INDEX (A.E.I) [4]

The reciprocal of twice the exposure, expressed in meter-candle-seconds, at the point of the TOE of the CHARACTERISTIC CURVE where the slope equals 0.6 gamma when recommended processing and exposure conditions are used.

AFFECTIVE COMBINATION, LAW OF [6]

The "pleasantness" value of a combination of colors is highly dependent on the "pleasantness" of the component colors. This law holds for CHROMATIC as well as ACHROMATIC colors.

AFTER-IMAGE (AFTER-SENSATION)

A visual sensation occurring after stimulation has ceased which was caused by and appears as the previous stimulation.

Note: Staring at a target on film for many seconds (time varies between individuals) can cause an after-image of that target and interfere with subsequent viewing.

See Also: AFTER-IMAGE, NEGATIVE; AFTER-IMAGE, POSITIVE; AFTER-IMAGE, PURKINJE

AFTER-IMAGE, HERING [5]

The first POSITIVE AFTER-IMAGE which occurs following a brief light stimulus.

AFTER-IMAGE, NEGATIVE (COMPLEMENTARY AFTER-IMAGE)

A visual after-image in which black and white shades are reversed and the colors are usually approximately COMPLEMENTARY to those of the original response.

AFTER-IMAGE, POSITIVE (HOMOCHROMATIC AFTER-IMAGE)

A visual after-image in which black and white shades are the same and the colors are approximately the same as those of the original response.

AFTER-IMAGE, PURKINJE

A visual after-image in which black and white shades are the same and the colors are approximately COMPLEMENTARY to those of the original response.

Ag.

Chemical symbol for silver.

AGITATION [4]

The process of circulating the photographic solution in which the film or paper is immersed. To bring fresh solutions into contact with the emulsion. Bubbling nitrogen through the solutions is a commonly used method of agitation.

AIRY DISK [4]

The image of an infinitely distant point as focused on a plane by a diffraction limited lens. Because of the wave structure of light, this image is never simply a point, but a small disk, no matter how perfect the lens.

AIRY RINGS

The rings (or diffraction patterns) surrounding the AIRY DISK caused by the DIFFRACTION characteristics of the optical system.

ALBEDO

The ratio of reflected-to-incident light.

Note: This ratio for any one surface is independent of the intensity of light source.

ALCOHOL, ABSOLUTE

Chemically pure ethyl alcohol without water.

ALCOHOL, DENATURED

Ethyl alcohol rendered unfit for drinking by the addition of agents known as denaturants. Almost all industrial alcohol is denatured.

ALCOHOL, METHYLATED

English term for one kind of denatured alcohol.

ALTITUDE

Vertical distance of an object or point above DATUM, usually mean-sea-level.

ALYCHNE

The line or locus of points on the CIE CHROMATICITY DIAGRAM that corresponds to the CHROMATICITY COORDINATES of the normal colors that have zero luminosity. By locating two of the three CIE PRIMARIES at the extremes of the alychne the CIE Committee made the CIE $\bar{y}$ color-matching function identical with the PHOTOPIC CURVE of the STANDARD OBSERVER. This was done to facilitate the computation of photometric quantities from color matching data.

AMAUROSIS

Loss of sight due to defect of the optic nerve which is not accompanied by any perceptible change in the eye itself.

AMBLYOPIA

Dimness of vision for which no organic defect in the refractive system of the eye has been discovered.

Note: Found in total color-blindness, in albinism, in toxic conditions, and is associated with the excessive use of drugs.

AMERICAN NATIONAL STANDARDS INSTITUTE
See ANSI

AMERICAN STANDARDS ASSOCIATION

Old name for what is now the American National Standards Institute. See ANSI.

ANAGLYPH

A stereogram in which the two views are printed or projected superimposed in complementary colors, usually red and green. By viewing through filter spectacles of corresponding COMPLEMENTARY colors, a stereoscopic image can be viewed.

ANALOGOUS COLORS

Analogous colors are those which have some perceptible similarity or close relationship with respect to one or more of the attributes of color; as, closely related in HUE, or BRIGHTNESS, or SATURATION.

Note: Usually the term refers to the relation of hues alone; as, reds and oranges or greens and yellow-greens are called Analogous hues or colors.

ANALYTICAL DENSITOMETRY (ANALYTICAL DENSITIES)

A means of determining the amounts of the individual colorants (CYAN, MAGENTA, and YELLOW dyes) in an element of a photographic image.

Note: There are three types of Analytical Densities (see also): ANALYTICAL SPECTRAL DENSITY; EQUIVALENT NEUTRAL DENSITY; and EQUIVALENT NEUTRAL PRINTING DENSITY.

ANALYTICAL SPECTRAL DENSITY (ASD)

The density of a single dye or colorant at a single wavelength.

Note: In color films, it is a measure of the amount of dye deposit in a dye layer.

ANAMORPHIC LENS

A lens which does not magnify equally along mutually perpendicular axes.

ANASTIGMAT

A lens which has been corrected for ASTIGMATISM.

ANASTIGMATIC LENS [4]

See ANASTIGMAT

ANGLE

The difference in direction between two intersecting lines.

Note: The unit measures of an angle are the Degree (the 1/360 part of a circle) or the Radian (the angle resulting when the length of an arc is equal to its radius). 1 Radian = 57° 17' 44".

ANGLE OF COVERAGE [4]

The apex angle of the cone of rays passing through the front NODAL POINT of a lens. Lenses generally are classified according to their angles of coverages, as follows:

narrow-angle -- Less than 60°
normal-angle -- 60° to 75°
wide-angle -- 75° to 100°
super-wide angle or ultra-wide angle -- Greater than 100°

ANGSTROM UNIT ($\mathring{A}$) [4]

An old unit of measure for the wavelength of light, equal to one tenth of a nanometer: for example, the visible spectrum extends from about 4,000$\mathring{A}$ to 7,000$\mathring{A}$ (400 to 700 nanometers).

ANOMALOSCOPE

An apparatus for determining color deficiencies in human vision.

See Also: NAGEL ANOMALOSCOPE

ANOMALOUS TRICHROMATIC VISION (ANOMALOUS TRICHROMATISM) [5]

A form of defective color vision in which three primaries are required for color matching, but the proportions in which they are matched differ significantly from those required by the NORMAL TRICHROMAT.

Note: Generally these people can see all colors but are weak in a particular color. There are three forms of Anomalous Trichromatism -- PROTANOMALOUS, DEUTERANOMALOUS, and TRITANOMALOUS VISION. They cover the ranges of defective color vision lying between normal trichromatism and complete PROTANOPIA, DEUTERANOPIA, or TRITANOPIA, respectively.

See Also: PROTANOMALOUS VISION; DEUTERANOMALOUS VISION; TRITONOMALOUS VISION

ANSI

American National Standards Institute, formerly United States of America Standards Institute (USASI), and before that American Standards Association (ASA).

ANSI (Continued)

Because of widespread usage, some ANSI standards retain the designation ASA as in ASA speed.

ANTI-FOGGING AGENT (ANTIFOGGANTS; FOG RESTRAINERS)

Chemical included in a DEVELOPER or EMULSION to retard the formation of development FOG.

ANTI-HALATION BACKING [4]

A light-absorbing coating applied to the back side of the support of a film or plate (or between the EMULSION and the SUPPORT) to suppress HALATION.

ANTI-REFLECTION COATING

Very thin coating of a metallic fluoride applied to a glass surface -- e.g., of a lens -- to reduce light lost by reflection. The most commonly used anti-reflection-film material is magnesium fluoride, MgF_2.

See Also: COATED LENS

ANTI-VIGNETTING FILTER

A filter to correct variations in illumination across the focal plane. The rear of the filter (over the lens) is coated with neutral material whose DENSITY gradually decreases from the center toward the edges to cut down the exposure of the center portion.

Note: Color images taken without this filter will have darkened corners and edges. However, these filters are often not used because they reduce the overall light level.

See Also: VIGNETTING

APERTURE-COLOR PERCEPTION [5]

Perception of color as filling an aperture in a screen.

Note: An aperture-color perception is non-located in the sense that it may be near the plane of the screen or indefinitely far behind it, but it tends to be seen closer to a plane perpendicular to the line of sight. It has a filmy, soft character in contrast to a SURFACE-COLOR perception which has a hard character corresponding to an exact location in space.

See Also: FILM-COLOR

APERTURE

An opening or hole through which light or matter can pass.

See Also: APERTURE, EFFECTIVE

APERTURE, EFFECTIVE [4]

The useful area of the opening through which the ray of light passes to the film to produce the image.

APERTURE, NUMERICAL

The sine of the half angle of the widest cone of light rays capable of being transmitted through a lens system, multiplied by the INDEX OF REFRACTION of the medium in which the object is embedded.

APERTURE STOP [4]

The physical element (such as a stop, DIAPHRAGM, or lens periphery) of an optical system which limits the size of the pencil of rays traversing the system. The adjustment of the size of the aperture stop of a given system regulates the brightness of the image without necessarily affecting the size of the area covered.

APERTURE, WORKING [4]

The largest DIAPHRAGM opening at which a lens diaphragm can be set.

APOCHROMATIC LENS [4]

A lens which is corrected for CHROMATIC ABERRATION at three wavelengths (blue, green, and red) of light rather than two, as in the ACHROMATIC LENS (green and red).

APOLSTILB (asb) (METER-LAMBERT)

A unit of LUMINANCE equivalent to $\frac{1}{\pi}$ candela/meter^2.

Note: See Table 1 in the Appendix.

APTITUDE, COLOR

See COLOR APTITUDE

APPEARANCE PLAN

A method of developing color systems in which the intervals on the dimensions of colors are based on human judgment. The MUNSELL COLOR SYSTEM is an example.

AQUEOUS HUMOR [11]

A clear liquid (Specific Viscosity = 1.03) which fills the chamber between the CORNEA and the LENS.

Note: See Figure 1 in the Appendix.

ARBITRARY THREE-FILTER DENSITIES

Densities measured with a DENSITOMETER whose responses do not conform to any particular colors or density measuring conventions. Any combination of filters or photo tubes may be used.

AREA EFFECT [6]

A change in color of an object as it varies in size (independent of distance) on the retina.

Note: As the area increases (up to 20 degrees subtended on the retina and under most conditions) so does saturation. Past 20 degrees the color becomes progressively less saturated.

ARTIFICIAL LIGHT

Any illumination not produced by the sun but which has a wide range of wavelengths, generally appearing white.

See Also: INCANDESCENT TUNGSTEN LIGHT; FLUORESCENT LIGHT

ASA [4]

American Standards Association, now reorganized under the name American National Standards Institute (ANSI).

ASA (AMERICAN STANDARDS ASSOCIATION) COLOR MEASUREMENT METHOD (Z58.71-1951)

Commonly used method of measuring color by spectrophotometry followed by calculation of CIE tristimulus values (see TRISTIMULUS VALUES, definition 2).

ASA SPEED [8]

System of rating the speed of sensitized materials laid down by the American Standards Association (now ANSI) in the ASA standards PH2.5 -- 1960 for black-and-white negative materials and PH2.21 -- 1961 for color reversal materials. The ASA speed for black-and-white negative emulsions is based on measurement of a prescribed point of the CHARACTERISTIC CURVE which is at a minimum density level above base + fog density and satisfies certain conditions of slope. The ASA speed can be expressed either as an arithmetical speed -- e.g., ASA 100 -- or in a logarithmic form where each successive step represents a change in sensitivity by a factor of 2 -- e.g., ASA 5°. This form distinguishes the ASA speed from the older, numerically similar exposure index figure.

With reversal color films, the speed is based on the CHARACTERISTIC CURVES of the three dyes but is expressed in the same way.

Numerically, ASA speeds are identical with B.S. (British Standard) speeds as specified by B.S. 1380: 1962.

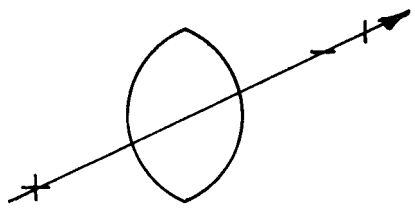
ASSIMILATION EFFECT

In complex patterns, colors evoked by small, spatially juxtaposed areas may appear more alike than different. When judging or naming colors, adjacent colors may cause perceptual errors; therefore, it is better to isolate the colors being judged or named.

ASTIGMATISM

A defect or aberration of an optical system which results in lines perpendicular to one another in the object plane being focused in different image planes.

Note: In the Figure below is an example.



ATMOSPHERIC ATTENUATION

The absorption and scattering of light as it passes through the atmosphere. The attenuation affects the various wavelengths of light differently.

See Also: RAYLEIGH SCATTERING; MIE SCATTERING

ATMOSPHERIC SCATTERING

See Also: RAYLEIGH SCATTERING; MIE SCATTERING

ATMOSPHERIC TURBULENCE

Variations in the density of the air caused by variation in temperature and air pressure.

Note: Degrades high-altitude imagery by distorting the image as it passes through the atmosphere and reduces resolution. Furthermore, atmospheric turbulence tends to degrade the small image details or higher spatial frequencies more than it degrades the gross features or lower spatial frequencies in the image.

ATTENUATION COEFFICIENT

It is the proportionality constant that relates the amount of light lost (ΔI) from a beam of light to the amount of light (I) that remains after the beam has traveled a distance (Δx) in the material, that is, $\Delta I = -kI\Delta x$

where ΔI = amount of light lost
Δx = distance traveled
I = amount of light remaining
k = attenuation coefficient

Each material has a different attenuation coefficient at each wavelength.

Note: The loss can result from scattering, absorption, or both. When the only loss is that due to absorption, the term Absorption Coefficient (similarly defined) is used.

ATTITUDE [4]

The angular orientation of a platform or of the photograph taken with that platform with respect to some external reference system. Usually expressed as PITCH, ROLL, and YAW.

ATTRIBUTES OF COLOR (DIMENSIONS OF COLOR) [5]

The CHROMATIC colors have the attributes of HUE, SATURATION, and BRIGHTNESS or LIGHTNESS, but the ACHROMATIC colors do not have those of hue and saturation. All colors have the general attributes of duration, location, and extent, but these are rarely mentioned.

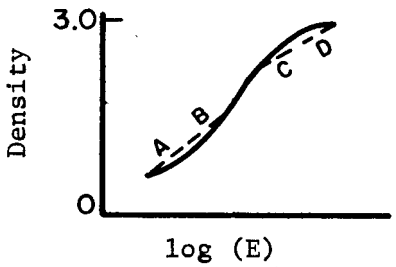
AUBERT-FORSTER LAW [5]

A generalization from the Aubert-Forster phenomenon, namely, that VISUAL ACUITY of a near object in the periphery is greater than that of a similar, distant object, even though the latter is large enough to subtend the same visual angle as the near object.

AVERAGE GRADIENT

A measure of contrast for a specified portion of the CHARACTERISTIC CURVE, (slope of the line between any two points on the curve). There are no widely accepted definitions of the two points; therefore, they should be specified.

Note: In the figure below, the slopes A and B and C and D are Average Gradients.



AVOIRDUPOIS WEIGHT (AVDP) [4]

The system of weights in general use in the United States. The avoirdupois pound is defined as 453.5924277 grams. The smallest unit of the system is the grain, 7,000 equal one pound; the next larger unit is the dram, 256 equal one pound; the next larger unit is the ounce, 16 equal one pound.

AXIS, OPTICAL (PRINCIPAL AXIS) [4]

In a lens element, the straight line which passes through the centers of curvature of lens surfaces. In an optical system, the line formed by the coinciding principal axes of the series of optical elements (lenses).

AXIS, VISUAL

An imaginary line from the object through the NODAL POINT of the eye to the FOVEA.

B

BACK FOCUS (BACK FOCAL LENGTH) [4]

Term used to designate the distance between the back surface of a lens and the aerial image when the camera is focused at infinity.

BAFFLE [4]

Used for the absorption of stray light within a camera or other optical instrument.

BALANCE, COLOR

See COLOR BALANCE

BAROMETRIC ADMITTANCE [4]

The transmission of ULTRAVIOLET LIGHT from the sun is inversely proportional to the BAROMETRIC PRESSURE. Thus, at high altitudes where the pressure is low, trouble is often experienced with the excessive proportion of ultraviolet light. The ultraviolet light admittance at 29.92 inches of mercury (sea-level) is regarded as the standard.

Note: In high-altitude photography UV is usually not a particular problem since the camera faces toward the earth and the UV has been absorbed by the air column. However, at oblique angles the problem could arise.

BAROMETRIC PRESSURE [4]

The pressure of the atmosphere expressed in inches of millimeters of mercury column height. At sea-level, the average barometric pressure is 760 mm of mercury or 29.92 inches of mercury at 15 C (59 F).

BEAM

A shaft or column of light, a bundle of rays.

BEAM SPLITTER

An optical device for dividing a light beam into two separated beams (e.g., a partially silvered mirror). Usually, there must be a color correction made because the beam splitter may be wavelength sensitive; thus, changing the color of the transmitted and reflected light.

Note: In ADDITIVE COLOR SEPARATIONS the beam splitter is used to transmit a portion of the light to one film and reflect a portion to another film. Selective filters may be placed in front of each film.

BEER'S LAW [6]

(1) Stated formally: for a molecularly dispersed colorant of a given thickness, the amount of transmitted flux (I_t) of single-frequency light of wavelength λ is a function of the amount of incident flux (I_o), the extinction coefficient (a_λ) and the concentration (c) of the medium.

$$I_t = I_o e^{-a\lambda c}$$

(2) A mathematical expression relating transmittance of a single wavelength through a colored medium to the INCIDENT FLUX, extinction coefficient, and the concentration of the medium.

See Also: BOUGUER's LAW

BEZOLD-BRÜCKE PHENOMENON

A change in hue resulting from a change in LUMINANCE. As luminance increases, colors which are orange or yellow-green appear yellower and colors which are purple or blue-green appear bluer. The colors of blue, green, yellow, and red generally remain the same.

Note: If the luminance (such as that from a light table) remains the same during color viewing or naming, the effect will not be a problem.

BINOCULAR COLOR MIXTURE [5]

The presentation of different colors to corresponding areas of the two retinas, resulting in a single fused impression. This effect occurs only under special conditions, often the effect is BINOCULAR RIVALRY.

Note: During stereo viewing, if the two images are slightly different in color (which is normally true due to change of acquisition angle), the colors may be fused or the colors will alternate in dominance.

BINOCULAR FLICKER [5]

Flicker evoked by rapidly alternating presentation of stimuli to the right and left eyes, usually in such a manner that the gaps in the stimulus presented to one eye are filled by the stimulus presented to the other.

BINOCULAR FUSION [5]

The combination of two images falling upon the two retinas forming a single visual impression. The images may be alike or may differ to some degree in form and color.

Note: Stereoscopic viewing is an example of BINOCULAR FUSION.

BINOCULAR MATCHING [1]

The matching of stimuli, such as colors, by presenting the two stimuli to be matched to the right and left eyes respectively, and, ideally, having them occupy the two halves of a combined visual field. To avoid BINOCULAR FUSION of the two stimuli, fixation points should be provided.

BINOCULAR RIVALRY (RETINAL RIVALRY)

Alternating sensations, first from one eye and then from the other, when the two eyes are simultaneously stimulated by different colors or figures.

BINOCULAR RIVALRY (RETINAL RIVALRY) (Continued)

Note: For example, if one eye is presented with blue and the other red, one can get the sensation of blue, then red, then blue, and so on. In stereoscopy, if the color of one image is different from the other, this effect can occur.

BINOCULAR VISION [5]

Vision with the two eyes operating conjointly, usually with fixation of both on the same objective point.

In general, characterized by a single perception of the objects fixated. An important factor in perception of space, giving projection and depth.

See Also: MONOCULAR VISION (for comparison)

BIPACK

A film consisting of two layers, each layer sensitive to a different portion of the SPECTRUM.

Note: Most color films consist of three layers and are called TRIPACKS.

See Also: TRIPACK

BIPOLAR CELLS

The first layer of nerves leading away from the RODS and CONES towards the front of the eye. Activity in this layer is passed on to the next layer, GANGLION CELLS, at the junction called SYNAPSES.

BLACK

(1) Total (or near total) absence of reflected light

(2) The ACHROMATIC COLOR of minimum lightness or brightness.

BLACK AND WHITE INFRA-RED FILM

A phrase used to denote Kodak Infrared Aero Film 5424 which is a negative material of average resolution, sensitized to IR radiation, as well as to the visual spectrum. Should be used with a Wratten 89 B filter to cut out visible wavelengths.

BLACKBODY [8]

Theoretically, a perfect source of (radiant energy) and a body which absorbs all RADIANT ENERGY striking it.

The conception of such a hypothetical reference source is found useful in stating the SPECTRAL POWER DISTRIBUTION of light or COLOR TEMPERATURE (in photography).

When a solid substance is heated, it glows first dull red, then brighter red, and finally white. Discounting any light reflected from the surface, the power distribution of the radiation emitted by the substance depends on the temperature to which it is heated. This is completely true for a blackbody -- i.e., one which reflects no light falling on it.

BLACKBODY [8] (Continued)

In experimental physics such a blackbody is obtained by cutting a circular opening in one side of a hollow, metal sphere. Owing to the shape of the body, most of the light entering the opening is absorbed inside the sphere and virtually none emerges again. This aperture is therefore black--i.e., the "blackbody"--and, upon heating the sphere, the light emerging is solely composed of radiant power due to the heating.

The spectral power distribution of any incandescent light source can be stated in terms of the absolute temperature at which a blackbody emits rays of the same WAVELENGTH DISTRIBUTION. This temperature is referred to as the COLOR TEMPERATURE of the LIGHT.

Apart from the above mentioned sphere, there is no such thing as a perfect blackbody; all substances reflect a certain amount of light which mixes with that emitted on heating. So the spectral composition of the light they emit is not absolutely proportional to their temperature. In many cases, however, the discrepancy is not serious.

BLACKBODY LOCUS

See PLANCKIAN LOCUS

BLACKBODY RADIATION

Radiant power emitted from a blackbody and having the SPECTRAL POWER DISTRIBUTION given by PLANCK'S LAW, i.e., a distribution determined solely by the temperature of the radiating body.

BLACK CONTENT

In the OSTWALD COLOR SYSTEM, B is the BLACK CONTENT in the equation W + B + C = 1, which OSTWALD considered as describing the appearance of all related colors.

See Also: OSTWALD COLOR SYSTEM

BLACK LIGHT [8]

Black light is the name for ultraviolet illumination when it is used to make objects visible in the dark. The objects are treated with a dye or pigment which fluoresces under the ultraviolet radiation.

The source consists of a mercury arc or other suitable light screened by a filter (e.g., covered with a lacquer) which cuts out all the visible rays but the ultraviolet.

BLEACH

(1) To make whiter.

(2) A chemical used for bleaching.

(3) In color processing, a solution that changes all developed silver into soluble silver salts for later removal.

(4) In black and white processing, a solution to remove developed silver. Part of the process of changing from a negative to a positive transparency.

BLEACHING [8]

Converting a silver image (negative or positive) into a more or less colorless silver compound, such as silver chloride, bromide, iodide, or complex salts containing chromates, ferrocyanides, etc., of other metals as well. Bleaching forms the initial stage of a large number of toning processes for transparencies and prints (where the additional metal compounds often produce the color of the toned image), as well as many intensification methods.

BLEACH-OUT PROCESS [5]

A process for making color prints from a color transparency, by using a support coated with a mixture of dyes, each of which is capable of being decolorized by exposure to light in a different portion of the spectrum or by subsequent chemical action controlled by a photographic image.

BLIND SPOT (OPTIC DISC) [5]

An irregular area in the retina which is not sensitive to light-stimulation because it lacks rods and cones. The exit point of the OPTIC NERVE.

Note: The blind spot is around 6.5° of visual angle in diameter and is situated about 15° to the nasal side of the center of the retina, corresponding to the place of exit of the optic nerve. The blind spot explains the substantial gap in the temporal side of the monocular visual space.

Note: See Figure 1 in the Appendix.

BLISTERS [4]

Small bubbles formed under the emulsion due to the detachment of the emulsion from the paper or film.

Bubbles, elliptical in shape and larger than one-quarter inch.

BLOCKED UP [4]

Applied to highlights in a photographic negative which are so overexposed or overdeveloped that no detail is visible.

BLOOM [5]

An appearance characteristic of high-gloss surfaces where the highlights have a hazy border.

BLUE [5]

(1) The hue visual sensation typically evoked by stimulation of the normal human eye with radiation of wavelength approximately 476 nanometers.

(2) Any hue predominantly similar to that of the typical blue.

(3) The COMPLEMENT of YELLOW.

BLUE-YELLOW BLINDNESS

A rare type of partial color-blindness, in which blue and yellow stimuli are confused because the color gamut is reduced to reds, greens, and grays.

BLUE-YELLOW BLINDNESS (Continued)

See Also: TETARTANOPIA

BLURRY [5]

Having uncertain outlines.

BLURRED NEGATIVES [4]

Any negative showing indistinct outlines of the image or double outlines is "blurred". This may be due to: (1) A poor lens, (2) Camera out of focus, (3) Camera motion, (4) Image motion, (5) Platen vacuum failure.

"
BOSTROM TEST

A defective color-vision test based on colored figures being perceived on a differently colored background. Not extensively used or known.

BOUGER'S LAW [6]

(1) Stated formally: for a molecularly dispersed colorant of a given concentration, the transmitted flux (I_t) of single-frequency light of wavelength λ is a function of the incident flux (Io), the EXTINCTION COEFFICIENT (a_λ) and the thickness (1) of the medium:

$$I_t = I_o e^{-a_\lambda l}$$

(2) A mathematical expression relating transmittance of a single wavelength through a colored medium to the INCIDENT FLUX, EXTINCTION COEFFICIENT, and thickness of the medium. More simply, equal layers of a transparent material absorb equal fractions of each kind of energy entering them.

(3) Also known as LAMBERT'S LAW, but not the same as LAMBERT'S COSINE LAW.

See Also: BEER'S LAW

BRIGHT [5]

BRILLIANT, lively in appearance, opposite of dull. Characterized by a relatively high degree of BRIGHTNESS.

BRIGHTNESS [5]

(1) Brightness is the LUMINOUS INTENSITY of any surface in a given direction per unit of projected area of the surface as viewed from that direction.

$$B = dI_{\theta}/dA \cos \theta$$

where I_θ = Intensity, A = Area, and θ is the angle between the direction of observation and the normal to the surface.

(2) In common usage, the term brightness usually refers to the INTENSITY of sensation which results from viewing surfaces or space from which light comes to the eye. This sensation is determined in part by the definitely measurable "brightness" defined above and in part by conditions of observation, such as the state of adaptation of the eye.

BRIGHTNESS (Continued)

Note: In the defining equation above, θ is the angle between the direction of observation and the normal to the surface. In practice, few surfaces follow exactly the Lambert's Cosine Law of emission or reflection; hence, the brightness of a surface generally is not uniform but varies with the angle at which it is viewed. Brightness can be measured not only for sources and illuminated surfaces, but also for virtual surfaces such as the sky.

BRIGHTNESS CONSTANCY

The perceptual phenomenon in which an object appears to have the same brightness under various levels of illumination.

BRIGHTNESS CONTRAST

A BRIGHTNESS difference between a visual area and its surrounding. The greater the difference, the higher the contrast.

Note: The equation is

$$\frac{LI_o - LI_b}{LI_b} \times 100$$

where LI = Luminous Intensity, o = object, and b = Background.

See Also: BRIGHTNESS RATIO

BRIGHTNESS PURITY

See LUMINANCE PURITY

BRIGHTNESS RANGE [8]

Term indicating the ratio of the BRILLIANCE of the extreme highlights to the darkest shadows of a scene or image.

See Also: CONTRAST; GAMMA

BRIGHTNESS RATIO [5]

The ratio of the brightnesses of any two surfaces. When the two surfaces are adjacent, the brightness ratio is commonly called the BRIGHTNESS CONTRAST.

See Also: BRIGHTNESS CONTRAST

BRIGHTNESS THRESHOLD, ABSOLUTE

The minimum LUMINANCE level of a stimulus (with a particular SPECTRAL DISTRIBUTION) required for the stimulus to be seen. The value is determined after complete DARK ADAPTATION but does not exclude the effect of processes normally active in the sense organ.

Note: The absolute Brightness Threshold under optimal conditions is about .001 to .005 foot-lambert for FOVEAL CONES and .000001 foot-lambert for RODS [6].

BRIGHTNESS THRESHOLD, DIFFERENTIAL

The JUST-NOTICEABLE DIFFERENCE between two brightness levels, or $\frac{B_o - B_b}{B_o + B_b}$ where B = Brightness, o = object and b = background.

BRIGHTNESS THRESHOLD, DIFFERENTIAL (Continued)

Note: The Differential Brightness Threshold under optimal conditions is about .02 to .05 over an extended range of luminance (about 1 to 1,000 foot-lamberts).

BRILLIANCE

Another name for LUMINOSITY, i.e., the intensity of light reflected from a surface (incident light intensity X reflectivity of surface).

See Also: LUMINOSITY

BROCA-SULZER EFFECT

The maximum brightness sensation occurring .05 to .2 seconds after the onset of a steady (state) light.

BROWN

A dark orange

BRUNSWIK RATIO [11]

A measure of COLOR CONSTANCY. A ratio which indicates the degree an object retains its color when viewing conditions are changed.

Note: The ratio is expressed as $\frac{S-S'}{L-S'}$ where L = luminance of unshadowed area, S' = luminance of shadowed area, and S = luminance of the experimental match to the shadowed area.

See Also: THOULESS RATIO

BULK COLOR

See VOLUME COLOR PERCEPTION

BURNHAM-CLARK-MUNSELL COLOR MEMORY TEST [6]

A short-term color memory test in which the subject looks at a color chip for 5 seconds, and then it is covered. Five seconds later the subject chooses from a group of 43 differently colored chips the one which matches the covered chip. 20 colors are tested. People are scored "Superior", "Normal", or "Low".

C

CALLIER QUOTIENT [4]

The ratio between DIFFUSE and SPECULAR DENSITY as measured on a given photographic emulsion (also called "Q-Factor").

Note: A low Q-factor means that light is being absorbed rather than being scattered by the emulsion. A high Q-factor means the opposite is occurring.

CAMOUFLAGE DETECTION FILM

See COLOR INFRARED FILM

CAMPIMETRY

The measurement of the extent colors are perceived from the FOVEA. The test uses a Campimeter which is a flat chart for mapping the color sensitivity of the entire RETINA.

See Also: COLOR ZONES

CANDELA (Formerly CANDLE) [4]

The international unit of LUMINOUS INTENSITY of a source of light; the luminous intensity, in the direction normal to a BLACKBODY surface of 1/600,000 sq. meter in area at the temperature of solidification of platinum under a pressure of 101,325 newton/meter^2.

Note: See Figure 4 in the Appendix.

CANDLE [4]

See CANDELA

CANDLEPOWER [4]

LUMINOUS INTENSITY expressed in terms of the CANDELA.

Note: Use as "The Candlepower of the light source is 60 candelas".

CARDINAL POINTS [4]

In a thick lens system, the two PRINCIPAL POINTS, the two NODAL POINTS, and the two FOCAL POINTS.

CARDINAL STIMULI [5]

Four standard visual stimuli by means of which the three reference stimuli and the basic stimulus of any TRICHROMATIC system may be defined. For example, light of wavelengths 700, 546.1 and 435.8 nm and Illuminant B have been used by the CIE.

Note: Any three-color system should have red, blue, and green stimuli plus an illuminant. Cardinal stimuli are simply those colors and the illuminant chosen.

See Also: CIE COLOR SYSTEM; CIE SOURCES; TRICHROMATIC COLOR SYSTEMS.

CEILING

The height above the earth's surface of the lowest layer of clouds or obstruction phenomena that is reported as "broken", "overcast", or "obscuration" and not classified as "thin" or "partial".

Note: Preferably, color should be acquired when there is no ceiling (full sun) and must be acquired below ceiling.

CELSIUS (°C)

Formerly known as Centigrade. A temperature scale in which the freezing point of water is labelled 0° and the boiling point 100°.

CENTIMETER

A measure of length; 1/100 of a meter; abb.: cm

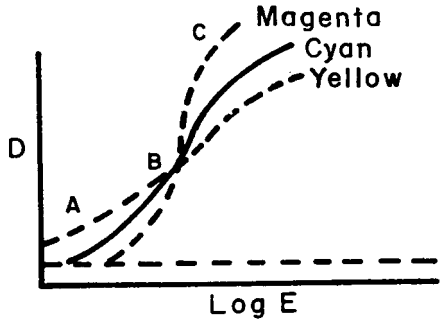
CENTIGRADE (°C.)

Now known as CELSIUS.

CHARACTERISTIC CURVE (H AND D CURVE; SENSITOMETRIC CURVE; D LOG E CURVE)

A curve showing the relationship between exposure and resulting density in a photographic image, usually plotted as the optical density D [D = log (1/T) (T-Transmittance or amount of light passing through an area divided by the total amount of light striking the area) or degree of blackening of an exposed film] against the logarithm of the exposure (log E) in candela-meter-seconds.

Note: In the Figure below is a set of Characteristic Curves for the three dye layers of a color film where A is the TOE; B is a STRAIGHT LINE portion, and C is called the SHOULDER. The Characteristic Curve is extremely important and from it can be obtained (in part) the ASA SPEED of the film, CONTRAST, EXPOSURE LATITUDE, D-MAX, D-MIN, and GAMMA.



CHEMICAL FOG [4]

DENSITY produced on photographic paper or films by chemical means such as too energetic or contaminated DEVELOPER.

CHOROID

The tissue layer, which contains many blood vessels to nourish the eye, that lies between the SCLERA (outer tissue of the eye) and the RETINA.

Note: See Figure 1 in the APPENDIX.

CHROMA

(1) Synonomous with SATURATION (but also with COLOR).

CHROMA (Continued)

(2) The dimension of the MUNSELL COLOR SYSTEM which corresponds most closely to saturation.

Note: The word CHROMA has been used in many ways. To avoid confusion it should only be used with reference to the Munsell Color System. Otherwise use the term "saturation".

See Also: MUNSELL COLOR SYSTEM; SATURATION; VIVID.

CHROMASTEREOPSIS

A binocular illusion of depth which occurs when viewing small, highly saturated targets or areas against homogeneous backgrounds of a widely separated wavelength, e.g., a red body against dark blue water. The target will appear to stand out from the background even though it may have no height; if it does have height, it will be exaggerated.

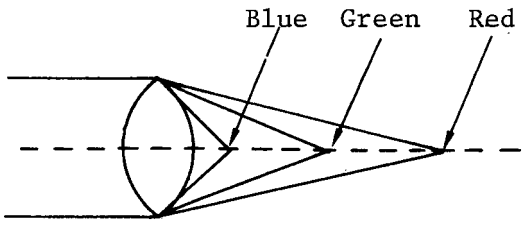
CHROMATIC

Chromatic means having some perceptible degree of SATURATION and HUE.

CHROMATIC ABERRATION [4]

A defect (unequal REFRACTION) in a lens which causes rays of light of different wavelengths to be brought to a focus at different points in the space. There are two types: LONGITUDINAL CHROMATIC ABERRATION and LATERAL CHROMATIC ABERRATION.

Note: In the Figure below, blue, green, and red wavelengths are focused on different planes because of longitudinal chromatic aberration.



CHROMATIC ADAPTATION

See ADAPTATION, CHROMATIC

CHROMATIC COLOR [5]

A color which has HUE and SATURATION.

See Also: ACHROMATIC COLOR (for comparison)

CHROMATIC CONTRAST

See COLOR CONTRAST; SIMULTANEOUS COLOR CONTRAST

CHROMATIC DISCRIMINATION [18]

Ability to distinguish CHROMATICITY differences.

CHROMATIC FLICKER [5]

A pulsating or flicker phenomenon caused by differences in HUE and SATURATION, either singularly or combined, that occurs between stimuli of equal LUMINANCE which are alternately applied to the same retinal area.

CHROMATIC FLICKER [5] (Continued)

Note: Distinguished from flicker in general which may involve pulsations in brightness.

CHROMATIC RESOLVING POWER

See RESOLVING POWER, CHROMATIC

CHROMATICITIES OF CIE STANDARD SOURCES [5]

The chromaticities of the CIE standard for COLORIMETRY are:

Source A	x = 0.4476	y = 0.4075
Source B	= 0.3485	= 0.3518
Source C	= 0.3101	= 0.3163
Source D_{65}	= 0.3127	= 0.3291

See Also: CIE SOURCES; DAYLIGHT D ILLUMINANTS

CHROMATICITIES OF OTHER IMPORTANT SOURCES AND ILLUMINANTS [5]

The approximate chromaticities of various sources and illuminants are indicated by the following CHROMATICITY COORDINATES:

Sunlight	x = 0.336	y = 0.350
Average Daylight	0.313	0.328
North Sky Light	0.277	0.293
Zenith Sky	0.263	0.278
White Flame Carbon Arc	0.315	0.332
Daylight Fluorescent Lamp (6500 K)	0.313	0.329
White Fluorescent Lamp (4500 K)	0.359	0.363
White Fluorescent Lamp (3500 K)	0.404	0.396

CHROMATICITY

(1) The quality of a color specified by DOMINANT WAVELENGTH (alternatively, COMPLEMENTARY WAVELENGTH for purples) and PURITY, taken together.

(2) In the CIE system of color measurement, Chromaticity is expressed mathematically by two numbers, x and y, termed CHROMATICITY COORDINATES; a diagram showing the ranges of these coordinates for all colors is termed a CHROMATICITY DIAGRAM.

Note: CHROMATICITY is equivalent to the common concept of quality as distinguished from quantity of light.

CHROMATICITY COORDINATES

In the CIE system, they are the ratios of each of the three TRISTIMULUS VALUES (X, Y, and Z) of a sample color to the sum of the tristimulus values:

$$x = \frac{X}{X + Y + Z},$$

$$y = \frac{Y}{X + Y + Z}, \text{ and}$$

$$z = \frac{Z}{X + Y + Z}$$

CHROMATICITY COORDINATES (Continued)

They are the coordinates for the CHROMATICITY DIAGRAM; See Figure 2 in the Appendix.

CHROMATICITY DIAGRAM

A plane diagram formed by plotting one of any set of three chromaticity coordinates against another.

Note: See Figure 2 in the Appendix for an example of the Diagram.

CHROMATOPSIA [5]

An abnormal state of vision in which colorless objects appear colored. For example, yellow after santonin, red after snow-blindness.

CHROMOGENIC DYE FORMATION

Dye formed as a result of the chemical reaction between the oxidized COLOR DEVELOPER (the exhausted form remaining after the DEVELOPMENT of image silver) and the DYE COUPLER.

CHROMOSCOPE [5]

A type of colorimeter using color produced by the rotary dispersion of quartz as standards. Somewhat out-of-date.

CIE

Abbreviation for Commission Internationale de l'Eclairage, the French title of the International Commission on Illumination.

See Also: ICI

CIE COLOR DIFFERENCE FORMULAS AND UNITS

See COLOR DIFFERENCE FORMULAS AND UNITS

CIE COLOR MATCHING FUNCTIONS

See COLOR MATCHING FUNCTIONS

CIE COLOR SYSTEM

The CIE Color System is a color designating system based on the physical aspects of light and color perception.

Note: This system is too complex to fully describe here. The reader is referred to references [1], [6], and [17].

CIE DISTRIBUTION COEFFICIENTS

See DISTRIBUTION COEFFICIENTS

CIE ILLUMINANTS (CIE STANDARD ILLUMINANTS)

Spectral power distributions defining standard illuminants for colorimetric calculations. Included are the spectral power distributions of CIE SOURCES A, B, C and the spectral power distributions defining the CIE Daylight D illuminants.

See Also: DAYLIGHT D ILLUMINANTS

CIE PURITY

See PURITY

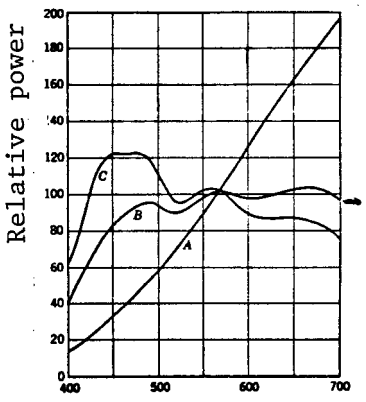
CIE SOURCES (CIE STANDARD SOURCES)

Source A: A gas-filled incandescent lamp operating at 2854 K.

Source B: Same as above, but with a filter to produce an approximation to noon sunlight. (COLOR TEMPERATURE of 4870 K).

Source C: Same as A, but with a filter to produce an approximation to overcast skylight. (Color temperature of 6740 K).

Note: See Figure below:



Wavelength, nm

See Also: CHROMATICITIES OF CIE STANDARD SOURCES; DAYLIGHT D ILLUMINANTS

CIE STANDARDS [8]

Standards of illuminants and of color perception set up by the Commission Internationale de l'Eclairage (International Commission of Illumination) to provide a means of accurately describing colors. Also known as ICI standards or (in Germany) IBK standards.

CIE TRISTIMULUS VALUES

See TRISTIMULUS VALUES

CILIARY BODY

A body of tissue which contains three groups of muscle fibers to change the shape of the LENS of the eye during focusing.

Note: See Figure 1 in the Appendix.

CINCHING [4]

Tightening a roll of film by holding the spool and pulling the free end; frequently results in parallel scratches or abrasion marks.

CIRCLE OF CONFUSION (CIRCLE OF LEAST CONFUSION) [4]

The circular image of a distant point object as formed in a focal plane by a lens. A distant point object (e.g., a star) is imaged in a focal plane of a lens as a circle of finite size because of lens aberrations.

CLARITY OF COLOR [5]

Clarity of color means clearness of color in contrast to muddiness.

CLEAN (CLEAR) [5]

Free from a tendency to be dull, dingy, gray, dusty, or CLOUDY in appearance.

CLOUDY [5]

Blotchy, uneven color of "milky" appearance.

COATED LENS [4]

A lens whose surfaces have been coated with a transparent film of such thickness and index of refraction as to minimize the light loss due to reflection.

See Also: ANTI-REFLECTION COATINGS

COLLIMATING LENS (COLLIMATION OPTICS) [4]

A lens or optics which makes convergent or divergent rays parallel.

COLLIMATION

(1) The process of making light rays parallel.

(2) The process of aligning the OPTICAL AXES of optical systems.

COLOR [4]

(1) A general term for the quality of light distinguishable by the visual sense, e.g., black, white, gray, light blue, red, dark yellow, etc.

(2) That property of an object which is dependent on the wavelength composition of the light it reflects, emits, and transmits.

See Also: CHROMATIC COLOR; ACHROMATIC COLOR; METALLIC COLOR

COLOR APTITUDE

The ability to work with colors, e.g., color naming, color matching, color discrimination, and a good color memory. This aptitude can be improved with practice and experience with colors.

COLOR ATLAS

A collection of color samples usually used for visual matching.

COLOR BALANCE [4]

(1) The relative adjustment of the overall intensities of the ADDITIVE or SUBTRACTIVE PRIMARIES in a color reproduction in order to give the best reproduction.

(2) The proper intensities of colors in a color reproduction which, when balanced, give a correct reproduction of the gray scale.

Note: Color balancing is a complex processing problem. Lack of proper balancing may result in imagery having a bluish, reddish, yellowish, etc., appearance. However, it should be noted that the reverse is not always true, i.e., yellowish imagery is not necessarily due to improper color balancing.

COLOR BLINDNESS

Color vision defect marked by a partial (DICHROMATIC VISION; ANOMALOUS TRICHROMATIC VISION) or a total loss of color vision (MONOCHROMATIC VISION).

COLOR COEFFICIENT

The photographic image on a negative may be pure black or it may be colored. If the color is non-actinic with respect to the printing paper used, the print obtained will have more contrast than one from an untinted, but otherwise identical, negative. The ratio of the GAMMA of the colored negative, as determined from the print made from it, to the gamma of an otherwise identical negative is termed the Color-Coefficient, or the Color-Coefficient of contrast.

COLOR, CLASSES OF [5]

Colors may be divided generally into two distinct classes, CHROMATIC and ACHROMATIC.

ACHROMATIC COLORS vary only in BRIGHTNESS. CHROMATIC COLORS vary in BRIGHTNESS, HUE, and SATURATION.

See Also: METALLIC COLORS

COLOR COMPARATOR

An instrument designed for the comparison of colors.

Note: The widest use of color comparators is the determination of the concentration of a known constituent in a solution; such instruments are sometimes called Chemical Colorimeters.

COLOR COMPENSATING FILTERS

See FILTER

COLOR CONSTANCY

Colors generally do not appear to change with varying illumination levels or types even though the wavelength composition may have changed.

Note: A U. S. Army vehicle that is partially shaded may appear to have the same continuous olive-drab color when, in fact, the shaded portion is a darker color.

See Also: BRUNSWIK RATIO; THOULESS RATIO

COLOR CONTRAST

See CONTRAST, COLOR

COLOR CONVERSION [18]

Change in any dimension of perceived color due to change in any conditions of viewing.

COLOR CO-ORDINATE TRANSFORMATION [7]

Computation of TRISTIMULUS VALUES of colors in terms of one set of PRIMARIES from the tristimulus values of the same colors in terms of a different set of primaries.

COLOR COUPLERS (DYE COUPLERS)

Chemicals that form dyes in the emulsion by reacting with the oxidized products formed during DEVELOPMENT. The amount of dye in any one place is proportional to the exposure in that layer of the color film.

COLOR CORRECTION

A term usually applied to lenses or optical systems to refer to their designs which insure that they minimally alter or imbalance the wavelengths of light passing through.

Note: For example, lenses which focus red at a different plane than blue are not Color Corrected. Color imagery and panchromatic films (sensitive to a wide range of wavelengths) must be acquired with Color Corrected optical systems.

COLOR CORRECTION FACTOR (to a photometer)

The factor by which the readings of a PHOTOMETER must be multiplied in order to obtain values in conformity with the V_λ function for light of a spectral composition different from that by which the photometer was calibrated.

COLOR-DIFFERENCE FORMULAS

Mathematical formulas used to express numerically the perceptual difference between two colors.

Note: There are many different formulas, all which disagree with one another and none of which agree perfectly with visual perception.

COLOR DEFICIENCY

A general term for all forms of color vision different from normal. Includes MONOCHROMATIC VISION, DICHROMATIC VISION, and ANOMALOUS TRICHROMATIC VISION.

COLOR DENSITOMETER

A device which measures the RADIANT FLUX for three bands of wavelengths (red, blue, green) by using three filters whose peak absorption wavelengths are at or near the absorption peaks of the three colorants used in the color reproduction being measured.

See Also: COLOR DENSITOMETRY

COLOR DENSITOMETRY

The measurement of dye densities in color reproductions. There are two major types of measurements: ANALYTICAL DENSITOMETRY and INTEGRAL DENSITOMETRY.

COLOR DEVELOPER [5]

A chemical substance or mixture of substances capable of reducing silver halides with the simultaneous production of an insoluble colored product (a DYE) in regions of the silver deposit.

COLOR FIDELITY

A term generally applied to the degree that colors on an image match those of the original scene.

Note: No known color film has perfect color fidelity although fidelity is quite good when acquired properly. Color Fidelity is severely affected by atmospheric attenuation and improper exposure settings.

COLOR FORMERS

A compound added to the emulsion layer which reacts with the oxidized COLOR DEVELOPER to form specifically colored dyes, e.g., YELLOW DYE, MAGENTA DYE, and CYAN DYE.

COLOR GAMUT

The range of colors produced by a given method.

COLOR INFRARED (IR) FILM

A Kodak false-color film (Ektachrome Infrared 8443) which is also known as Camouflage Detection film. The emulsion layers are sensitive to green, red, and infrared wavelengths. Living vegetation emits infrared wavelengths and appears red on the film and dead vegetation appears yellowish/ brownish on the film. Thus, dead vegetation used as camouflaging materials can be distinguished from living vegetation.

COLOR INTERVAL [5]

The degree of visual difference between two colors measured in steps of HUE, VALUE, and CHROMA.

COLOR MATCH

Any two visual sensations which appear to be the same in terms of color.

COLOR MATCHING

The procedure of determining whether two visual sensations are the same in terms of color. Color matching is usually done with a sample color and a set of reference colors. One attempts to select one of the reference colors which has the same (or nearly the same) color as the sample color.

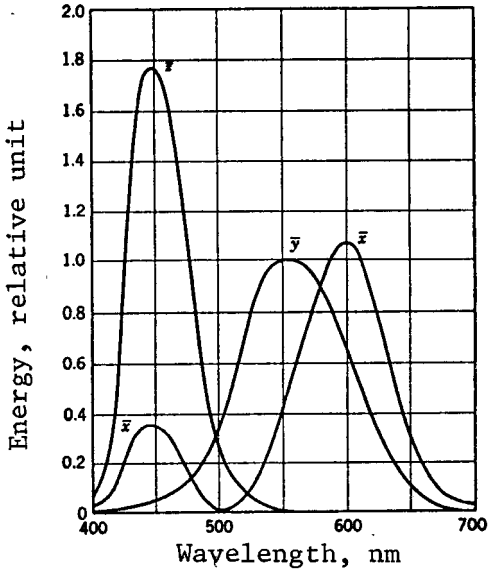
Note: Color matching should be done with the same type and intensity of illuminant and the eyes must be LIGHT-ADAPTED.

See Also: VISUAL COLORIMETRY, INSTRUMENTAL COLORIMETRY

COLOR MATCHING FUNCTIONS

In the CIE color system they are designated as $\bar{x}$, $\bar{y}$, and $\bar{z}$ and represent the color matching properties of a standard observer.

Note: See Figure below for the distributions.



COLOR MATCHING FUNCTIONS (Continued)

See Also: STANDARD OBSERVER

COLOR MIXTURE

The combination of two or more colors.

COLOR-MIXTURE DATA

(1) The amounts of red, blue, and green light needed to be combined to perceive a particular color.

(2) The amounts of the colorimetric primaries (red, blue, and green) to establish a color match with a sample color.

COLOR NEGATIVE FILM

A photographic film whose colors after DEVELOPMENT are COMPLEMENTS of the original scene.

COLOR NORMAL

A person with normal color vision.

See NORMAL TRICHROMATIC VISION

COLOR NOTATION

Symbols arranged in some orderly fashion by which the attributes of color may be communicated either verbally or written. For example, in the MUNSELL COLOR SYSTEM the Color Notation 5Y 4/10 is used to communicate a particular yellow color.

COLOR PERCEPTION

The visual experience of color.

COLOR PHOTOGRAPHY [4]

The reproduction of subject or scenic matter in natural colors by photography.

COLOR POSITIVE FILM

A photographic film whose colors after DEVELOPMENT are nearly the same as the original scene.

COLOR PYRAMID

See COLOR SOLID

COLOR RENDERING

The effect a light source has on the appearance of colors compared to the effect produced with a standard or reference light source.

COLOR RENDERING INDEX

A measure of the degree to which the perceived colors of a set of test objects illuminated by a source as compared to their perceived colors when illuminated by a standard source under specified conditions. The index ranges from 0 to 100. An index of 100 means that the source affects the appearance of color the same as the standard. An index of 50 is an example of the shift from fluorescent light to incandescent light.

Note: The basic problem with this index is understanding what the

COLOR RENDERING INDEX (Continued)

numbers mean in terms of perceived colors. For example, how the colors are perceived when illuminated by a source with an index of 83 is difficult to determine.

COLOR REVERSAL FILM

See REVERSAL FILMS, COLOR

COLOR SCALE [5]

An orderly arrangement of colors showing graduated change in HUE, SATURATION, or BRIGHTNESS.

COLOR SENSATION [5]

Any visual experience of a CHROMATIC nature which results from stimulation of the retina, as distinguished from the physical considerations descriptive of the stimulus.

COLOR SENSITIVITY

The sensitivity of a photographic emulsion or the retina of the eye to light of various wavelengths.

COLOR SEPARATION NEGATIVES

The separate photographic records (usually 3 panchromatic negatives) of the relative intensities of the primary colors (reds, greens, or blues) in a scene or color image (transparency or print).

See Also: ADDITIVE COLOR SEPARATIONS

COLOR SHADES

The variations in brightness or lightness of a color, e.g., light red, dark red.

COLOR SOLID [5]

A symbolic figure in three dimensions which represents the relations of all possible colors with respect to their primary attributes of hue, brightness or lightness, and saturation. Usually brightness (lightness) appears as the vertical axis of the figure, with hue and saturation represented in polar coordinates about the brightness axis, and saturation being radial. The boundaries of the solid are actually irregular, but it is sometimes represented as a cylinder, a sphere, a spindle, a double cone or a double pyramid with a common (square or triangular) base.

COLOR SPECIFICATION [5]

A description of a color made in such a way that the color sensation may be duplicated. This may be done with the aid of certain visual color matching devices, such as COLORIMETERS or COLOR COMPARATORS.

See Also: COLOR NOTATION

COLOR STANDARD

A color whose dimensions of HUE, SATURATION, and BRIGHTNESS have been accurately measured and specified and then used for comparison purposes.

COLOR STANDARD (Continued)

Note: Munsell chips are in a sense Color Standards when they are used to determine the name or designation of other colors.

COLOR STIMULUS [5]

(1) RADIANT ENERGY of any luminance and wavelength composition within the ranges which are capable of adequate stimulation of retinal receptors.

(2) The term is sometimes limited to adequate stimuli for evoking the sensation of HUE.

COLOR SURFACE [5]

A plane section of a COLOR SOLID (usually taken perpendicular to the axis of brightness variation) that represents all possible hues and saturations at a single brightness level.

COLOR TEMPERATURE

The temperature (in Kelvin) of a BLACKBODY radiator whose SPECTRAL DISTRIBUTION matches that of the color being designated.

Note: The blackbody colors form a single series of relatively unsaturated visual qualities, ranging from red, through orange, white, pale blues, and violets as the temperature is increased. For example, if a light source has a SPECTRAL DISTRIBUTION which matches that of a blackbody at 3,000 Kelvin, then the light source is said to have a Color Temperature of 3,000 Kelvin.

See Also: CORRELATED COLOR TEMPERATURE; RECIPROCAL COLOR TEMPERATURE; BLACKBODY; MIREDS

COLOR THRESHOLD

The luminance below which color becomes no longer discernible. The level varies for different colors, but minimum is about 10^{-3} candelas/square meter at which red is first perceived.

COLOR TRANSPARENCY [5]

A color photograph upon a glass or film support to be viewed or projected by transmitted light, as distinguished from a color photograph on paper or other opaque white support to be viewed by reflected light.

COLOR TRIANGLE [5]

A diagram (typically) in the form of an equilateral triangle with apices representing red, green, and blue primaries and the enclosed area representing all the CHROMATICITIES possible by additive mixture of these three primaries.

Note: Characteristic of the color triangle is the adjustment of the primary scales so unit amounts will yield an achromatic mixture which is represented by the centroid of the triangle; and the relative amounts of the primaries necessary to yield each chromaticity are then indicated by corresponding distances on the triangle.

See Also: COLOR SOLID; CHROMATICITY DIAGRAM; MAXWELL TRIANGLE

COLOR VISION [5]

Vision with the response of CHROMATIC COLORS.

COLOR VISION THEORIES

See Table 2 in the Appendix for brief descriptions. Individual theories listed in Table 2 may also be found in the Glossary.

COLOR WEAKNESS [5]

A defect in color vision marked by diminished color sensitivity rather than actual loss of sensitivity to any HUE.

See Also: ANOMALOUS TRICHROMATIC VISION

COLOR ZONES (COLOR FIELDS) [5]

Regions of the retina which have different characteristics as to chromatic color response.

Note: For most individuals and usual conditions, the central region shows full chromatic color response, while red and green responses disappear at a moderately peripheral position and blue and yellow fail toward the extreme periphery. The exact size boundaries of any zone depend upon the size, intensity, and saturation of the stimulus used; they also vary with the individual and with the measurement technique employed.

See Also: CAMPIMETRY; PERIMETRY.

COLORANT

A DYE or PIGMENT which selectively absorbs particular wavelengths.

COLORED SHADOW PHENOMENON [5]

An accentuated type of SIMULTANEOUS COLOR CONTRAST observed when two shadows are cast upon the same surface near each other by two lights of different color; when the shadows are made about equal in brightness, each one tends to appear of a color COMPLEMENTARY to that of the light which casts it.

COLORIMETER [5]

A color measuring instrument for comparing a known color to an unknown color so that the latter is specified in terms of the former. The colorimeter may be calibrated or the specification may be transformed to yield a measurement in terms of some standard system of colorimetry.

Note: Generally, the instrument is used to determine approximate CIE Tristimulus values X, Y, and Z for a transparent or opaque sample.

See Also: SPECTROPHOTOMETER: TRISTIMULUS COLORIMETER

COLORIMETRY

The science of measuring color and expressing colors numerically. The measurements can be made visually or with devices.

COLORIMETRY (Continued)

See Also: VISUAL COLORIMETRY; INSTRUMENTAL COLORIMETRY

COLORIMETRIC DENSITIES

Density measurements on color films (using the STANDARD OBSERVER) used to determine how the colors will appear to the standard observer.

COLORIMETRIC PHOTOMETER [4]

A PHOTOMETER designed to measure the intensity of light of different colors through the use of filters interposed in the path of the light.

COLORIMETRIC PRIMARIES [5]

Any three colors which are additively mixed to match an unknown color when making a colorimetric measurement. Representative red, green, and blue stimuli are most commonly used as Colorimetric Primaries; but theoretically any three colors can be used if the color of any one cannot be matched by mixing the other two.

COLORIMETRIC PURITY [5]

EXCITATION PURITY multiplied by the ratio of the luminances of the spectrum color and the sample color.

Note: In the case of purples, the calculation is made using the spectrum color corresponding to the COMPLEMENTARY WAVELENGTH of the sample color.

COMA

A lens aberration affecting the sharpness of images off the OPTICAL AXIS which causes oblique light rays from a point source to be imaged as a comet-shaped blur. Thus objects will appear out-of-focus.

COMPARISON LAMP [5]

A Comparison Lamp is a lamp of constant but not necessarily known candlepower against which standard and test lamps are successively compared in a PHOTOMETER.

COMPLEMENT

One of a pair of colors (from light sources) which when mixed produces a neutral gray, white, or black. One of a pair of COMPLEMENTARY COLORS.

Note: Red is the Complement of Blue-Green; Green is the Complement of Blue-Red; Blue is the Complement of Yellow; and vice versa.

See Also: COMPLEMENTARY COLORS

COMPLEMENTARY COLORS (COMPLEMENTS) [7]

Two colors (from light sources) which when combined in the proper amounts mix to produce an ACHROMATIC COLOR.

Note: Complementary Colors are red -- blue-green (CYAN), green -- red-blue (MAGENTA), blue-- (YELLOW).

COMPLEMENTARY WAVELENGTH(S)

The wavelength(s) of light which when combined in suitable proportions with another color and matches an adopted ACHROMATIC COLOR is the Complementary Wavelength of the other color.

Note: The wide variety of purples (including nonspectral violet, purple, magenta, and nonspectral red colors) which have no DOMINANT WAVELENGTHS are specified by use of their Complementary Wavelengths in the CIE COLOR SYSTEM.

COMPLETE DIFFUSION [5]

Complete diffusion results when a diffusing medium scatters the light upon it so completely that none is regularly reflected or transmitted, and objects from which the light originally came cannot be distinguished.

CONE, RETINAL [5]

A type of minute structure found in the retina of the eye which constitutes a specific receptor for color vision. Distinguished from retinal RODS, another visual receptor; the cones are without visual purple (the chemical Rhodopsia) and are believed to operate for both CHROMATIC and ACHROMATIC (gray) visual qualities at higher levels of illuminations; the rods for achromatic only at low (twilight) levels. Currently, there are thought to be three types of cones sensitive to red, blue, or green. The rods and cones form the 2nd layer of the retina (from the surface of the eyeball). At the center of the retina (FOVEA) the cones are long and slender and closely packed to the exclusion of rods and farther out they are shorter and thicker and interspersed among the more numerous rods. It is estimated that there are 7,000,000 Cones in the human retina.

CONDITIONAL MATCH

A match between two colors which is agreed upon by most observers under most light sources.

CONSPICUITY

The tendency of colors to attract attention, particularly on color transparencies.

Note: The term is derived from the word "conspicuous" which means standing out from the background and immediately noticeable.

CONSTANCY

See COLOR CONSTANCY; BRIGHTNESS CONSTANCY

CONTACT PRINT [4]

A print made by placing a negative in contact with sensitive paper while exposure is being made.

CONTINUOUS SPECTRAL DISTRIBUTION

A SPECTRAL DISTRIBUTION that is never zero over a considerable spectral range.

See Also: SPECTRAL DISTRIBUTION

CONTINUOUS SPECTRUM [5]

A SPECTRUM or section of a spectrum in which radiations of all wavelengths are present.

CONTRAST [4]

In photography the difference between highlights and shadows. The ratio of reflecting power between the highlights and shadows of a print determines the contrast. Contrast in a transparency is determined by the ratio of the DENSITIES of the parts compared.

See Also: GAMMA

CONTRAST, COLOR [5]

(1) The ratio of the intensities of the sensations caused by two colors. Sometimes the logarithm of this ratio.

(2) Also used for SIMULTANEOUS COLOR CONTRAST

Note: High color contrast means that there is a large difference between the two intensities of two colors, e.g., yellow vs. black; whereas low color contrast means a small difference between the two intensities, e.g., pink vs. red.

CONTRAST FACTORS [4]

The amount of contrast in a finished photograph may be attributed to several factors. They include the exposure, the filter used, the type of film, the duration of negative development, the duration of exposure and development in printing, and the paper used in printing.

CONTRAST FILTER [4]

A color filter chosen to make a colored subject stand out very sharply from surrounding objects.

CONTRAST TRANSFER FUNCTION

See MODULATION TRANSFER FUNCTION

CONVERGENCE

The turning of the eyes inward as objects are brought close.

COOL COLORS [5]

Colors of green or blue or colors containing a marked predominance of green or blue.

See Also: WARM COLORS

CORNEA

The transparent area at the front of the eye and directly in front of the pupil and lens.

Note: See Figure 1 in the Appendix.

CORRECTION FILTER [8]

Term for any filter which alters colors to suit the color response of the film in use. Any color filter can be regarded as a correction filter.

CORRELATED COLOR TEMPERATURE

The color temperature of the blackbody whose CHROMATICITY is nearest that of the source considered. Used when the spectral power distribution of the source does not match that of any blackbody, even approximately. For example, the chromaticity of noon summer sunlight is closer to that of the blackbody radiator whose color temperature is 5740 K. Thus the correlated color temperature of noon summer sunlight is 5740 K, but the spectral power distributions of noon summer sunlight and a 5740 K blackbody are quite different.

Note: Fluorescent lights (as in light tables) have spectral distributions which do not match those of BLACKBODY radiators and thus have Correlated Color Temperatures.

COUPLER

See COLOR COUPLER

COVERAGE, ANGLE OF

See ANGLE OF COVERAGE

CRAB [4]

The condition caused by failure to orient the OPTICAL AXIS with respect to the track of the platform. In vertical photography, crab is indicated by the edges of the photographs not being parallel to the air-base lines.

See Also: YAW.

CRITICAL ANGLE [12]

The angle beyond which total INTERNAL REFLECTION of a ray takes place when passing from a medium of higher index to a medium of lower index. The angle is expressed by the equation sine $A = N'/N$, in which A is the critical angle, N' is the lower index of refraction, and N is the higher index of refraction.

CRYSTALLINE LENS

The LENS of the eye lying directly behind the AQUEOUS HUMOR; the shape of which is changed by the CILIARY BODY in order to focus the visual image onto the retina.

Note: See Figure 1 in the Appendix.

CULTURAL FEATURES

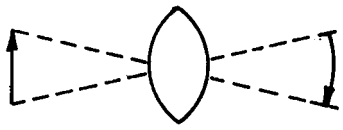
Features of the terrain that have been constructed by man. Included are such items as roads, buildings, and canals; boundary lines; and, in a broad sense, all items designated by names and legends on a map.

CURVATURE OF FIELD

A lens aberration which causes a flat object surface to be focused as a curved image surface. All good optical systems are corrected for this aberration.

Note: See Figure below. On imagery this aberration results in only the outer portions of the scene being out-of-focus.

CURVATURE OF FIELD (Continued)



CURVE OF LIGHT DISTRIBUTION

A curve showing the variation of LUMINOUS INTENSITY of a light source with the angle of emission.

CUTOFF FILTERS

See FILTER

CYAN [5]

The name applied to the blue-green colors or the wavelength of approximately 494 nanometers. Cyan is the hue COMPLEMENTARY to red.

CYAN DYE

During the processing of color film, it is the blue-green dye formed in the red sensitive layer.

Note: In positive transparencies it is formed where red wavelengths were not imaged, thus stopping the transmission of red except where it was imaged. In negatives it is formed where red wavelengths were imaged, thus allowing its complement (CYAN) to be transmitted.

See Also: YELLOW DYE; MAGENTA DYE

CYANINE (CYANIN)

Earliest known member of the class of cyanine dyes, a very large number of which have now been synthesized. The great majority of dyes used for sensitizing emulsions are of the cyanine class.

D

D-LOG E

See CHARACTERISTIC CURVE

D-MAX [4]

The highest density which can be obtained using a particular photographic material. When referring to a particular negative or positive, the highest density recorded.

Note: On the CHARACTERISTIC CURVE it is the highest density.

D-MIN. [4]

The lowest density on a positive or negative.

Note: On the CHARACTERISTIC CURVE it is the minimum density.

DALTONISM [5]

Same as COLOR-BLINDNESS.

Named for John Dalton, 1766-1844, who was himself color-blind for red and green and published a description of his case.

DARK

(1) Having the appearance of reflecting only a limited amount of light (tending toward BLACK).

(2) Dark colors are those of relatively low BRIGHTNESS or LIGHTNESS.

DARK ADAPTATION (DARKNESS ADAPTATION)

See: ADAPTATION, DARK

DARK-ADAPTED EYE

An eye whose condition has been so modified by the withdrawal of general light that its sensitivity to light has increased.

See Also: ADAPTATION, DARK

DARKROOM [4]

A room made free from light in which photographic operations are conducted. It is sometimes illuminated with a SAFELIGHT the rays of which are non-ACTINIC to the film or paper.

DATUM [4]

Refers to a direction, level, or position from which angles, heights, depths, speeds, or distances are conventionally measured.

DAY-BLINDNESS

A special condition, usually due to impairment of the central area of the RETINA, in which the individual sees better in dim light.

DAYLIGHT

The total visible RADIATION from the sky and sun.

DAYLIGHT (Continued) D

Note: Its SPECTRAL POWER DISTRIBUTION is shown in Figure 3 of the Appendix.

See Also: SKYLIGHT; SUNLIGHT.

DAYLIGHT D ILLUMINANTS

A series of CIE standard illuminants whose spectral power distributions are those of average daylight. CORRELATED COLOR TEMPERATURE is the variable within the series. The most important daylight D illuminant is D_{65}, with a correlated color temperature of 6500 K. Next in importance are D_{55} and D_{75}, with correlated color temperatures of 5500 and 7500 K, respectively. Formulas are available for calculating the spectral power distribution of any D illuminant with correlated color temperature between 4000 and 20,000 K. It is anticipated that ultimately D_{65} will replace CIE standard illuminants B and C for colorimetric calculations.

DEEP COLOR

Colors which are highly saturated.

DEFECTIVE COLOR VISION [5]

The condition in which color discrimination is significantly reduced in comparison with that of the NORMAL TRICHROMAT.

Note: The forms of defective color vision can be divided into three main groups - DICHROMATIC VISION, ANOMALOUS TRICHROMATIC VISION (all cases lying between normal trichromatism and complete dichromatism), and MONOCHROMATIC VISION.

DEFINITION [2]

Degree of clarity and sharpness of an image.

Note: A high degree of definition means that edges and details are sharp and colors are clear; implying high resolution, focus and good color fidelity, and balance.

DEGRADED COLOR

Colors which do not appear true or correctly balanced.

DENSE [4]

A term applied to negatives or positives in which the silver deposit is heavier than normal due to overexposure or over-development.

DENSITOMETER [4]

A device used to measure the OPTICAL DENSITY of deposits in a photographic image. There are many varieties, but all are alike in providing a means for comparing the intensity of a standard light to that of an identical beam of light which has passed through the area to be measured. Comparison between the two may be visual or by photoelectric cells. For determining the density of an image on paper, a Reflection Densitometer is used.

See Also: COLOR DENSITOMETER.

DENSITOMETRIC MUNSELL

A color measurement system based on the Munsell Color System where instead of determining a color by matching with Munsell Chips, the HUE, VALUE, and CHROMA are determined with a DENSITOMETER and a set of nomographs.

Note: Since a densitometer is used, colors on transparencies can be determined and referred to the MUNSELL COLOR SYSTEM.

DENSITOMETRY

The technique of measuring densities on photographic images. Can be carried out by transmitted light (e.g., on a transparency) or by reflected light (e.g., on a paper print). The instrument used for such measurement is a DENSITOMETER; the results may be used for plotting the CHARACTERISTIC CURVE of the material concerned or for EXPOSURE determination.

See Also: DENSITY; SENSITOMETRY; COLOR DENSITOMETRY

DENSITY

(1) The quantity per unit volume, area, or length.
(2) The degree of OPACITY as defined as $\log_{10}\left(\frac{1}{\text{Transmittance}}\right)$

or $\log_{10}\left(\frac{1}{\text{Reflectance}}\right)$

(3) In EMULSION, it is the amount of silver grains or color dye globules in a given area.

Note: There are many different ways of measuring densities on color emulsions. See ANALYTICAL, SPECULAR, DIFFUSE, INTEGRAL DENSITIES.

See Also: ABSORBANCE; OPTICAL DENSITY

DEPTH OF COLOR

The term usually refers to the "rich" quality of highly saturated colors.

See Also: DEEP COLOR

DESATURATED COLORS (PALE COLORS)

Colors in which the SATURATION is noticeably decreased as compared with a standard.

DESATURATION (DESATURATE) [18]

Reduction in SATURATION.

DESENSITISERS (DESENSITISING) [11]

A desensitiser is a substance which when applied to a sensitive emulsion reduces its sensitivity to light. Most desensitisers destroy, or partially destroy, the LATENT IMAGE on an exposed film; those that do not are mostly dyes. These are of great value in permitting even the fastest and most color-sensitive films, after a short treatment in total darkness, to be developed in a comparatively bright yellow light.

DETAIL [4]

The smallest discernible differences (e.g., object edges or colors) which are clearly defined; good detail implies high resolution and good focus.

DEUTERANOMALOUS VISION (DEUTERANOMALY; a DEUTAN) [5]

A form of ANOMALOUS TRICHROMATISM in which more green is required in a mixture of red and green to match a spectral yellow than in the case of the NORMAL TRICHROMAT. The relative spectral visual sensitivity does not differ noticeably from the normal but it is less in the red to green region. Hue discrimination is poor in the red to green region of the spectrum.

Note: In the population, it affects about 4.8% of males and .39% of females [6].

DEUTERANOPIA (a DEUTERANOPE)

Form of DICHROMATIC VISION in which green and purplish red stimuli are seen as grays. The deuteranope sees only spectral hues of blue and yellow and colors mixed therefrom.

Note: In the population it affects about 1.1% of males and .01% of the females [6].

DEVELOPER

A solution which converts the exposed grains of silver halide to metallic silver, forming the negative image.

DEVELOPER (Continued)

See Also: COLOR DEVELOPER

DEVELOPMENT [11]

Development is the production of a visible image from the invisible or LATENT IMAGE formed on sensitive material by exposure to light.

DEVELOPMENT BY INSPECTION [4]

Development of negatives or prints using direct observation and depending on the operator's judgment as to when development is complete.

DIAPOSITIVE [8]

Positive image on a transparent support intended for viewing by transmitted light, e.g., a transparency.

DIASCLERAL LIGHT

Light entering the eyeball through the SCLERA layer (outer coating).

DICHROIC [5]

Pertaining to the ability of some selectively absorbing substances to vary in color with layer thickness or concentration.

DICHROIC FILTER [5]

(1) A semitransparent mirror which selectively reflects some wavelengths more than others and so transmits selectively.

DICHROIC FILTER [5] (Continued)

(2) A filter transmitting two narrow regions of the spectrum.

DICHROISM

A term applied to a material which selectively transmits and reflects light depending upon its wavelength.

DICHROMATIC VISION (a DICHROMAT)

A form of defective color vision in which only two regions of the visual spectrum can adequately be perceived.

Note: In dichromatic vision the spectrum is seen as comprising only two regions of different HUE separated by a gray band. Dichromatic vision can be subdivided into three types: PROTANOPIA, DEUTERANOPIA, and TRITANOPIA.

See Also: PROTANOPIA; DEUTERANOPIA; and TRITANOPIA.

DICHROMATISM

(1) See DICHROMATIC VISION

(2) The property of varying in HUE either as the dye concentration is changed or as the thickness of the transmitting sample changes.

See Also: DICHROIC

DIFFERENCE LIMEN

The difference between two compared stimuli (e.g., two colors) which gives rise (statistically) to a perceived difference 50% of the times viewed.

See Also: JUST-NOTICEABLE DIFFERENCE

DIFFRACTION [4]

A term used in optics to denote the deviation of rays of light when such rays pass by the edge of an opaque body (a nontransparent object).

Note: As an example, DIFFRACTION causes the edges of shadows to appear blurred because the light rays passing the object are bent and spread.

DIFFRACTION GRATING

A device used to separate a beam of light into the SPECTRUM COLORS using the principle of DIFFRACTION. The device itself contains a series of fine grooves or wires which disperse incident light.

DIFFUSE DENSITY

The OPTICAL DENSITY measured when the incident light on the collection aperture of the DENSITOMETER is not highly COLLIMATED and the collection aperture subtends a large SOLID ANGLE.

Note: Most densitometers measure diffuse density.

DIFFUSED LIGHT [4]

Light which does not reach the object from a single direction.

Note: Sunlight which has been scattered by the atmosphere or clouds is an example of diffused light. Generally, as diffusion increases, shadow sharpness decreases.

See Also: DIRECT LIGHT

DIFFUSION

The change of the spatial distribution of a beam of radiation when it is deviated in many directions on arrival at a surface or in traversing a medium.

DIFFUSION CIRCLE [5]

A circle of color in an optical system caused by rays emanating from a point source which have not been brought into sharp focus because of CHROMATIC ABERRATION. A diffusion circle is likely to show different hues at different distances from its center.

DIN [4]

Deutsche Industrie Norm, German Standards.

DIN COLOR SYSTEM

The official German color system in which hue, saturation, and darkness (the opposite of lightness) are called FARBTON(T or F), SÄTTIGUNG(S), and DUNKELSTUFE(D), respectively. There exists a set of color chips,

DIN COLOR SYSTEM (Continued)

each with a set of 3 numbers, e.g., 3:1:6, which describe the hue, saturation, and darkness, respectively.

DIN SPEED

System of stating emulsion speeds as laid down by the Deutsche Industrie Norm (German standards organization).

See Also: ASA SPEED

DIOPTER [4]

The unit of measure of the converging or diverging power of a lens. It is equal to the reciprocal of the focal length in meters.

DIRECT COLORIMETRY

Color matching in a COLORIMETER for the purpose of numerical specification of color.

See Also: INDIRECT COLORIMETRY

DIRECT LIGHT [5]

Direct light is visible energy falling straight from its source upon the eye or upon an object.

DIRECT REFLECTION [5]

Reflection of light without scatter.

DIRECTIONAL REFLECTANCE [7]

The amount of light reflected from a surface in a specified direction compared to that reflected in the same direction from an ideal, nonabsorbing, perfectly diffusing surface placed in the same position and similarly illuminated.

DISCRIMINATION ELLIPSES

See: MacADAM ELLIPSES

DISPERSION [4]

The separation of a single ray of white light into a group of colored rays by a prism or other optical device.

Note: A Rainbow is an example of dispersed light.

DISPLACEMENT, ANGLES OF [5]

The angles by which the respective eyes deviate from the direction occupied in the primary position. The vertical displacement is the angle of the eye upward or downward from the primary position; the lateral displacement is the angle to right or left.

DISTORTION [4]

Any shift in the position of an image on a photograph which alters the perspective or spatial characteristics of the photograph.

DISTRIBUTION COEFFICIENTS (DISTRIBUTION FUNCTIONS) [5]

The relative TRICHROMATIC

DISTRIBUTION COEFFICIENTS (DISTRIBUTION FUNCTIONS) [5] (Continued)

COORDINATES of the spectral components of an equal energy spectrum. Denoted $\bar{x}$, $\bar{y}$, $\bar{z}$, in the CIE system and defined in a table of figures which represents the characteristics of the STANDARD OBSERVER.

See Also: COLOR MATCHING FUNCTIONS

DISTRIBUTION TEMPERATURE

The absolute temperature (in Kelvin, K) of the BLACKBODY RADIATOR for which the SPECTRAL POWER DISTRIBUTION at every wavelength in the visible spectrum (~400 to 700 nm) which is approximately proportional to that of the source considered.

DOMINANT COLOR

A term used to describe the principal color or tone in a picture.

Note: The Dominant Color of a jungle photograph is green.

DOMINATOR-MODULATOR THEORY

A vision theory stating that there exists a separate dominating receptor for the brightness aspect of vision with CHROMATIC distinctions introduced by other receptors modulating the response of the dominant receptor.

Note: See Table 2 in the Appendix.

DOMINANT WAVELENGTH

(1) On the CIE chromaticity diagram, it is the intersection of the SPECTRUM LOCUS and the line drawn through the chromaticities of the illuminant and the sample color.

(2) It is analogous to the concept of HUE.

Note: In Figure 2 in the Appendix, line A intersects the Spectrum Locus at 530 nm, thus 530 nm is the Dominant Wavelength of color N.

DRAM [4]

A unit of weight in the avoirdupois system, one-sixteenth part of an ounce or 27.34 grains.

DULL

Generally, Dull colors are desaturated and low in brightness.

DUNKELSTUFE(D)

In the DIN COLOR SYSTEM, a logarithmic function of the color's relative lightness. (Ratio of luminous reflection of color to the luminous reflection of the optimal color having the same CHROMATICITY.)

Note: Literally translated Dunkelstufe means "darkness degree".

DUPLICITY THEORY

The doctrine that visual sensation rests upon two distinct receptor

DUPLICITY THEORY (Continued)

systems present in the retina, the ROD and the CONE systems, respectively; the rod-system is supposed to be responsible for vision at low or twilight illumination levels and to yield an achromatic color; the cone supposedly mediates daylight and completes color vision but is inactive under twilight conditions.

Note: It is currently accepted as the major theory of vision.

DVORINE TEST

A type of PSEUDO-ISOCHROMATIC PLATE test of color vision where colored dot patterns lie on a background of colored dots. People with normal color vision will see the dot patterns correctly while those with defective color vision will not see the patterns correctly.

DYE

A complex chemical, whose molecules absorb particular wavelengths; used as a COLORANT or coloring agent.

Note: In color films, dyes (CYAN, MAGENTA, and YELLOW) are created in the emulsion as a result of the DEVELOPING process.

DYE COUPLER

See COLOR COUPLER

DYE DENSITY

(1) The logarithm to the base 10 of the OPACITY of an area in a finished dye image.

(2) The density of a dye deposit is the $\log_{10} \frac{1}{\text{Transmittance}}$ or $\log_{10} \frac{1}{\text{Reflectance}}$.

DYE FORMATION

See CHROMOGENIC DYE FORMATION

DYE GLOBULES

In a processed color positive or negative these are microscopic globs of dye which give the image its color. There are three colors, CYAN, MAGENTA, and YELLOW, and mixtures of these globs produce the entire range of colors. The globs are visible under high magnification.

DYE IMPURITIES [5]

Pertaining to the absorption of light by a dye in regions of the spectrum where the dye should transmit completely.

Note: All dyes are impure to some degree and thus cause some colors to be unfaithfully produced in the image.

DYE MORDANTING [5]

In color photography, the treatment of a silver image so as to replace it in whole or in part with a substance having an affinity for dyes.

DYE SENSITIZERS

Used to sensitize silver halide emulsions to certain desired portions of the spectrum.

E

EDGE FOG [4]

Fog on film caused by leakage of light between the flanges of the spool on which it is wound.

EFFECTIVE APERTURE

See APERTURE, EFFECTIVE

EFFECTIVE TRITANOPIA

See SMALL AREA TRITANOPIA

EFFICIENCY OF A SOURCE OF LIGHT [5]

The efficiency of a source is the ratio of the total LUMINOUS FLUX to the total power input. In the case of an electric lamp it is expressed in lumens per watt. In the case of a source depending upon combustion it may be expressed in lumens per thermal unit consumed per unit of time.

ELECTROMAGNETIC WAVES

The form in which RADIANT ENERGY travels or is propagated.

ELECTROMAGNETIC SPECTRUM

The name applied to all wavelengths of RADIANT ENERGY, e.g., LIGHT, radio, INFRARED, ULTRAVIOLET, X-rays, etc.

ELEMENT, OPTICAL

An optical part constructed of a simple piece of optical material, e.g., a lens, prism, or mirror.

EMISSION

The release of RADIANT ENERGY.

EMISSIVITY

The ratio of the RADIANT EMITTANCE of a source to the radiant emittance of a BLACKBODY at the same temperature.

EMITTANCE, SPECTRAL

See SPECTRAL EMITTANCE

EMMERT'S LAW [5]

The perceived size of an AFTER-IMAGE is directly proportional to the distance from the observer to the plane upon which the after-image is projected.

See also: AFTER-IMAGE

EMULSION

The sensitive coating on films, papers, and plates used in photography. It consists principally of a silver salt or salts suspended in gelatin. The emulsion may be sensitive to the whole visible spectrum (PANCHROMATIC, COLOR) or selected portions (INFRARED, ORTHOCHROMATIC).

EMULSION BATCH NUMBER [4]

A number placed on the label of film and paper packages which identifies the batch from which that particular film or paper was made.

EMULSION BATCH NUMBER [4] (Continued)

Note: Variations in film characteristics can be expected between batches.

EMULSION SPEED [4]

A property of photographic emulsions which determines how long they must be exposed to a given light source to secure equal density when developed. This speed may be given in ASA, DIN, Weston, Scheiner, or AEI scales.

See also: ASA SPEED

END EFFECT [6]

When a series of color samples varying only in saturation is presented on a neutral background, the end sample may be perceived more saturated than it really is.

ENERGY, RADIANT

See RADIANT ENERGY

ENLARGING [4]

The process of making a print or negative larger than the original by projection printing.

Note: Enlarging colored materials causes colors to become desaturated.

ENTRANCE PUPIL

The image of the limiting APERTURE STOP formed in the object space by all optical elements preceding the limiting aperture stop.

EQUAL ENERGY SOURCE [5]

A light source from which the amount of energy radiated is constant for the same wavelength interval throughout the visible spectrum.

EQUAL-ENERGY WHITE [7]

An achromatic light corresponding to equal radiance per unit of wavelength at all wavelengths.

EQUIVALENT FOCAL LENGTH

Same as FOCAL LENGTH and measured to the plane of best average DEFINITION throughout the angular field of the optical system.

See also: FOCAL LENGTH

EQUIVALENT NEUTRAL DENSITY (END)

END is defined as the OPTICAL DENSITY that a dye would have if the necessary amounts of the other fundamental dyes of a process were added to make it a neutral gray.

EQUIVALENT NEUTRAL PRINTING DENSITY

The same as EQUIVALENT NEUTRAL DENSITY (END) except that a printing material is used for visual judgment instead of direct vision.

ERYTHROPSIA

A type of CHROMATOPSIA or color vision (usually following over-exposure to intense light or prolonged staring at green light)

ERYTHROPSIA (Continued)

in which all objects appear tinged with red.

Note: Snow-blindness

EVEN COLOR

Uniformly, the same color over the surface.

EXCITATION PURITY

The ratio of the distances on a two-dimensional CHROMATICITY DIAGRAM from the adopted light source to the sample color and from the light source to the color lying on the SPECTRUM LOCUS or PURPLE BOUNDARY.

Usually indicated by the word "PURITY" alone and is similar to SATURATION.

Note: In Figure 2 in the Appendix $\frac{MN}{MP}$ is the Excitation Purity of the color N.

EXHAUSTION [4]

In photography, the state reached by any processing solution when the active ingredient is used up.

EXIT PUPIL

The image of the limiting APERTURE STOP in an optical system by all the lenses following this stop.

EXPOSURE

Exposure is generally understood to mean the length of time during which light is allowed to act on a sensitive surface. Technically, it is the product of the illumination of a unit area of sensitive surface and the duration of time through which the illumination acts.

Note: For colored material exposure is very critical. Even slight over- and under-exposure can affect color balance and fidelity.

EXPOSURE INTERVAL

The time interval between the taking of successive photographs.

EXPOSURE LATITUDE

The range of exposures that can be used for acquiring usable imagery. Determined by the slope of the CHARACTERISTIC CURVE and the D-MAX and D-MIN of the film.

Note: In color films the Exposure Latitude is usually very small.

EXPOSURE TABLE [4]

A table or set of tables to be used as a guide in determining correct photographic exposure.

EXTINCTION COEFFICIENT [5]

The natural logarithm to the base e of the reciprocal of the transmissivity.

EYE

The organ of vision which essentially focuses incoming

EYE (Continued)

light onto the RETINA where RODS and CONES are stimulated to begin the process of transmitting visual information to the brain.

Note: See Figure 1 in the Appendix for the structure of the eye; the parts of the eye are also discussed in the glossary.

EYE BASE

See INTERPUPILLARY DISTANCE

F

f-NUMBER [8]

Numerical expression of the relative aperture of a lens at its different stops (also the speed of a lens). The f-number is equal to the FOCAL LENGTH divided by the effective diameter of the lens opening and is written in various forms, e.g., f8, f/8, 1:8, etc.

FADED COLOR

A term applied to colors which have lost their brilliance or vividness (saturation).

FAHRENHEIT

A temperature scale in which the freezing point of water is 32 degrees and the boiling point is 212 degrees.

FALSE COLOR FILM

A film whose colors after processing are intentionally false compared to the colors of the scene.

See also: COLOR INFRARED FILM

FARBTON (T or F)

In the DIN COLOR SYSTEM it is analogous to the concept of HUE. There are 24 Farbtons.

FARNSWORTH DICHOTOMOUS TEST FOR COLOR BLINDNESS

A test designed to separate color normals from people with slight red-green deficiencies from those who are severely defective. The test is to arrange 15 Munsell papers (varying in HUE but not SATURATION or BRIGHTNESS) in a certain order. People who are color normals will arrange according to HUE, whereas DICHROMATS will arrange according to the saturation differences they perceive. The test allows for a number of people with light to moderate color deficiencies to be passed.

FARNSWORTH MUNSELL 100 HUE TEST

A color discrimination test which can classify those with normal color vision into superior, normal, and low color discrimination ability. It can also identify TRITANOPIA, PROTANOPIA, and DEUTERANOPIA but it should be used only to corroborate evidence of color deficiency. The test is to arrange in a certain order 4 sets of 25 MUNSELL papers within a given time limit.

FAST [5]

Will not fade or change in color on exposure to some named or implied agency such as light.

FATIGUE, RETINAL [5]

Depletion of the capacity of the retina to respond to light and color.

Note: Occurs with prolonged visual work.

FECHNER'S COLORS

When an ACHROMATIC light is flickered at low frequencies (about 51/sec) CHROMATIC color sensations may be perceived. These are known as Fechner's Colors.

FIDELITY, COLOR

See COLOR FIDELITY

FIDUCIAL MARKS [4]

Index marks (usually four) which are rigidly connected with the camera lens through the camera body and which form images on the negative and usually define the principal point of the photograph. Also, marks (usually four) in any instrument which define the axes whose intersection fixes the principal point of a photograph and fulfill the requirements of interior orientation.

FILM BASE [4]

A thin, flexible transparent sheet of plastic material which is coated with a light-sensitive emulsion.

FILM-COLOR [5]

Color seen as soft, non-substantial, indefinitely localized, and texture-free as perceived on a color transparency.

FILM SPEED [4]

That property of film which determines how much exposure must be allowed for a given light source in order to secure a negative of correct density and contrast.

See also: ASA SPEED

FILTER

Any transparent material (GLASS, GELATIN, or LIQUID) which by absorption selectively modifies the light transmitted through it.

Note: Filters may either absorb wavelengths equally and thus appear (and called) Neutral Gray; or they may selectively absorb certain wavelengths and not others, thus forming a HUE. For example, a red filter absorbs (or filters out) all wavelengths but red (which it transmits).

Filters may be used for the following reasons:

(1) To correct the imperfect color sensitivity of the film and make it translate the scene into colors that approximate the colors that appear to the eye. Such filters are called CORRECTION FILTERS.

(2) To distort (brighten or darken) the reproduction of certain colors for special effects. This intentional distortion is used to enhance contrast. Filters used in this way are called Effect Filters or CONTRAST FILTERS.

(3) To change the SPECTRAL DISTRIBUTION of the light which is important in color photography. Such filters are called Color Compensating Filters.

FILTER (Continued)

(4) To acquire imagery of a single color only; mainly used for scientific and other special purposes such as telephotography by infrared light. In principle, most of these filters are extreme cases of the contrast filters mentioned above.

(5) To remove or cut-off a portion of the spectrum. Such Filters are called Cut-off Filters.

FILTER, ANTI-VIGNETTING

See ANTI-VIGNETTING FILTER

FILTER, COLORED [5]

A filter which can modify the color of a light by selectively absorbing certain wavelengths and transmitting others.

FILTER, COLOR IR FILMS

For Color IR films a yellow filter is used to filter out blue wavelengths. A cut-off of 500 to 520 nanometers should be used.

FILTERS, COLOR SEPARATION

Filters used to obtain COLOR SEPARATION NEGATIVES. They are usually wide-band red, blue, or green filters.

FILTER FACTOR [4]

A number indicating the exposure increase necessary when using a filter as compared to the exposure necessary under the same conditions without the filter.

Note: Various factors must be considered including light level, color sensitivity of the film, and processing times.

FILTERS, GELATIN [8]

The most common camera filters are thin pieces of dyed gelatin. They are easiest to make accurately and offer the widest range of colors.

FILTERS, GELATIN GLASS [8]

When GELATIN FILTERS have to be constantly handled they are usually cemented between glass. Unless the workmanship of the cementing is good and the glasses are absolutely flat and parallel, the presence of the glass may upset the optical properties of the lens. The best filters for high-quality scientific work are prepared as optical flats of guaranteed accuracy. For most normal photography where such precision is not needed, the gelatin is usually cemented between flat and polished plate glass.

FILTERS, GLASS [8]

The better filters are made from colored glass. Such filters consist of glass only. While they are not so easily damaged as gelatin filters, the range of colors in which they can be manufactured is more limited.

FILTERS, HAZE

Used to reduce the effects of ATMOSPHERIC SCATTERING, they

FILTERS, HAZE (Continued)

reduce or cut off blue wavelengths. Often called MINUS-BLUE filters. Usually, a filter that does not transmit below 400 nm is used for medium haze and a filter that does not transmit below 420 nm is used for haze at about 12,000 feet. The filters used at extreme altitudes cut off at 450 to 500 nm. However, above 450 nm one can expect strong shifts in color balance toward the yellow.

FILTER, INFRARED

A deep red filter which absorbs almost all visible light but passes the infrared rays. It should only be used with infrared film.

See also: BLACK AND WHITE INFRA-RED FILM

FILTER, INTERFERENCE

A filter which transmits very narrow spectral regions as a result of interfering with the transmission of other wavelengths.

FILTERS, LIQUID [8]

For specific work special filters may be required which are not obtainable or practical with normal ready-made gelatin or glass filters. It is often more convenient to use solutions of certain colored chemicals in suitable glass cells. The thickness of the cell (i.e., the thickness of solution placed in the path of the light) determines the degree of absorption, while the choice of substance gives the necessary absorption characteristics. The main advantage of liquid filters is the exact reproducibility of characteristics. These depend on variables which are easily controlled with great precision: namely cell thickness and the composition and strength of the solutions used.

FILTER, NEUTRAL DENSITY [4]

A filter which absorbs and transmits wavelengths of light equally and is gray in color.

Note: These filters can be combined (stacked) to provide a wide range of densities.

FILTER OVERLAP [5]

The spectral region in which two or more given filters transmit light.

FILTER RATIO [4]

The ratio between the exposure required to produce the same density on a film when different filters are used.

FILTERS, ULTRA-VIOLET (UV) [4]

A filter which absorbs the ultra-violet rays but allows all visible light to pass; hence, no increase in exposure time is required when using this filter.

FIX [4]

To render a developed photographic image permanent by removing the unaffected light-sensitive material.

FIXER

A solution which dissolves soluble silver salts from the emulsion leaving a dye image.

FIXING [11]

The removal of any sensitive substance not acted upon by light or by the developer, thus rendering the emulsion or print unalterable by further action of light.

FLARE [4]

Non-image light which reaches the photographic emulsion during camera exposures. Its source may be any stray light falling directly on or reflected to the lens or internal lens reflections of image light. Its general effect is to lower the contrast of the image obtained.

FLAT [5]

A picture or scene which contains little contrast, i.e., the same lightness or darkness or grayness.

FLICKER PHOTOMETRY [5]

A method of PHOTOMETRY in which two different color stimuli are alternately presented to the eye at a suitable rate; the stimuli are considered equal in luminance when the flicker is minimum.

See also: PHOTOMETRY

FLIGHT OF COLORS [5]

The succession of color perceptions which follows an intense momentary light stimulus viewed against a dark ground.

FLUORESCENCE [5]

(1) The process by which a material absorbs RADIANT ENERGY and re-emits it in the form of radiant energy of a different wavelength band, all or most of whose wavelengths exceed that of the absorbed energy.

(2) The re-emitted radiant energy.

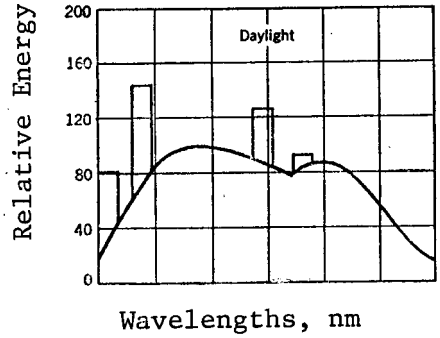
Note: Fluorescence, as distinguished from PHOSPHORESCENCE, does not persist for an appreciable time after the end of the excitation process.

FLUORESCENT LAMP

A fluorescent lamp is an electric discharge lamp in which the RADIANT ENERGY from the electric discharge is transferred by suitable materials (phosphors) into wavelengths giving higher LUMINOSITY.

Note: See Figure below for spectral distribution of a "DAYLIGHT" Fluorescent Lamp.

FLUORESCENT LAMP (Continued)



FLUX

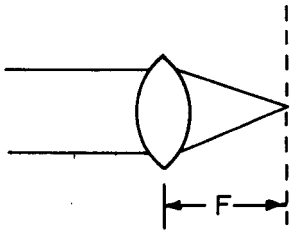
Rate of transfer of energy

See Also: RADIANT FLUX; LUMINOUS FLUX

FOCAL LENGTH [4]

The distance measured along the optical axis from the optical center (rear NODAL POINT) of the lens to the plane of critical focus on a very distant object.

Note: See Figure below; F is the focal length.



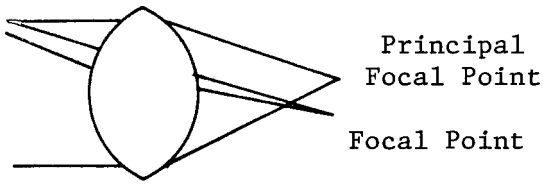
FOCAL PLANE [8]

Imaginary plane on which a lens forms a sharp image when correctly focused. For sharp pictures the emulsion surface of the plate or film in a camera must be accurately positioned in the focal plane of the lens.

FOCAL POINT (PRINCIPAL FOCUS) [8]

Point of intersection of all rays of light transmitted by a lens from a given object point. When the object is at infinity and the incident rays are parallel to the lens axis, the image is the Principal Focal Point and lies on the axis of the lens.

Note: See Figure below.



FOCUS [4]

(1) The point at which the rays from a point source of light reunite and cross after passing through a camera lens. In practice, the plane in which a sharp image of any scene is formed.

(2) To make adjustments to have the FOCAL PLANE and the emulsion layer coincide.

See Also: ACCOMMODATION

FOG [4]

(1) A fault in a negative seen as a veil over the whole negative either as darkened patches or as an obscuring of shadows (light areas in the negatives). It may be due to light accidentally reaching the negative (light fog), to an error in compounding or using solutions, or to gradual degeneration of the film or developer with age.

(2) A mist composed of water-vapor particles which may also contain dust and smoke.

FOOT-CANDLE [8]

A unit of ILLUMINANCE representing the light intensity over a surface one foot away from a standard CANDLE. It is equal to 1 LUMEN per square foot (1 lumen/ft^2) or 1.0764×10^{-3} LUX.

Note: See Table 1 in the Appendix.

See Also: LUMEN, LUX.

FOOT-LAMBERT

A unit of LUMINANCE equal to $\frac{1}{\pi}$ candela/ft^2. It is also equal to 1.0764 millilamberts, or 3.4263 candela/m^2.

Note: See Table 1 in the Appendix.

See Also: LAMBERT; METER-LAMBERT

FOUR-COLOR TEST

A quick color vision test for normalcy of yellow-blue and red-green vision.

FOVEA (FOVEA CENTRALIS) [5]

A small ellipse-shaped depression in the central region of the RETINA which measures somewhat less than a degree of visual angle at its maximum diameter and is characterized by the sharpest CONE vision.

Note: The Fovea is the center for visual fixation and attention and is practically 100% CONES. See Figure 2 in the Appendix.

FOVEAL CONES

Cones lying in the FOVEA.

FREEMAN ILLUMINANT-STABLE COLOR VISION TEST

A PSEUDO-ISOCHROMATIC test which separates color normals from red-green deficiencies. This test gives comparable results under several types of illuminants (COLOR TEMPERATURE of 2,000 K to 4,000 K). However, some dot patterns may be unfamiliar to many people who take the test.

FRINGE (RAINBOW EFFECT)

A defect of a color picture where edges are multicolored resulting from lack of registration of the component images. A fringe may be caused by parallax, error in

FRINGE (RAINBOW EFFECT) (Continued)

printing registration, or by movements of the object between the exposure or COLOR-SEPARATION NEGATIVES or ADDITIVE COLOR SEPARATIONS.

FULL APERTURE [4]

The maximum opening of a lens or lens diaphragm.

FULL COLOR CONTENT

In the OSTWALD COLOR SYSTEM it describes the maximum saturation of a HUE. Color Content is the dimension analogous to SATURATION.

FUNDAMENTAL RESPONSE CURVES

The set of three spectral sensitivity or mixture curves (one each for red, blue, and green sensitivities), usually plotted with relative luminosity as a function of wavelength, which represent the actual sensitivities of the fundamental retinal response processes, according to tri-receptor theories of color vision. The maxima of these response curves are believed to be 450, 540, and 590 nanometers, respectively.

See Also: STANDARD OBSERVER.

G

GAMMA [4]

A numerical designation for the CONTRAST of a photographic material as represented by the slope of the STRAIGHT-LINE portion of the CHARACTERISTIC CURVE. Gamma is numerically equal to the tangent of the angle which the straight-line portion makes with the base line. A gamma of 1 in a negative signifies that the lightness range in the negative is the same as the range of light values in the scene photographed; a gamma of .5 signifies that the lightness range in the negative is one-half of the lightness range in the scene.

See Also: CHARACTERISTIC CURVE

GANGLION CELLS [4]

The second layer of nerves leading away from the RODS and CONES which are activated by the BIPOLAR CELLS. Their axions pass across the inner retina and out of the eyeball to form the OPTIC NERVE.

GAP [4]

Any space where aerial photographs fail to meet minimum coverage requirements. This may be a space not covered by any photograph or a space where the minimum specified overlap or sidelap was not obtained.

GELATIN [4]

A transparent colloid which swells to a jelly-like mass in cold water but dissolves in hot water. Used as a medium for the silver salts in coating plates, films, and sensitized papers.

GELATIN FILTERS [5]

A filter in which gelatin is used as the vehicle for the absorbing material.

See Also: FILTERS, GELATIN

GENERAL COLOR [5]

A term applied to the tonality of a whole image.

Note: The general color of a jungle image is green.

GENICULATE BODIES, LATERAL

A pair of tissue bodies lying within the thalamus (portion of the brain) where the OPTIC NERVE connects with the OPTIC RADIATIONS.

GEOMETRIC METAMERISM

See METAMERISM, GEOMETRIC

GLARE [5]

The disturbance of the sensitivity of the eye experienced when portions of the field of view have a brightness

GLARE [5] (Continued)

or intensity greatly in excess of that of the average.

Note: Glare, as such, does not occur on images or prints, although one can identify glare from objects in the scene.

GLOBULES

Translucent dye particles in colored transparencies.

See Also: DYE GLOBULES

GLOSS [5]

Property of a surface which reflects a substantial proportion of the incident light in a mirror direction which is responsible for its shiny or lustrous appearance.

GLOSSY PAPER [8]

Photographic printing paper with a smooth shiny surface that can be further emphasized by glazing.

Note: A glossy surface is devoid of surface texture and is thus invisible-- like the surface of a polished mirror. It therefore shows up all the detail in the photograph. Since the smooth surface does not scatter light, a glossy print is better than a rough surface print because it shows brighter colors, is able to cover a greater brightness range, and can reproduce shadow detail better.

The light reflected from the fullest black on a glazed print is of the order of 1-2 percent of the incident light, while on a matt print it is around 5-10 percent. Assuming a maximum reflectivity of 80-90 percent from the pure white paper, the brightness range of a glossy print can be as high as 50 : 1 and of a matt print about 15 : 1 or 10 : 1.

The increased brightness range is important in copying or photomechanical reproduction and it explains why prints on glossy paper always reproduce best.

The glossy surface has its disadvantages: it shows up detail; and it tends to emphasize graininess, scratches, and other blemishes. Underexposed shadow areas show up as featureless black patches on glossy paper.

GODLOVE SMALL-COLOR-DIFFERENCE FORMULA

A formula used to compute color differences from differences in the MUNSELL HUE, VALUE, and CHROMA of the two colors being compared.

GONIOPHOTOMETER [5]

A device that measures directional reflectance and directional transmittance of a surface with collection of light confined to a narrow range of angles, the central ray of which is variable over a wide range of angles relative to the surface of the test specimen.

GOST SPEED [8]

Film speed rating in use in the Soviet Union and some eastern European countries. GOST speeds are quoted on an arithmetical scale and are fairly similar to the ASA arithmetical speed numbers. The GOST Speed criterion is based on the exposure point corresponding to a specified minimum density above base plus fog of the film.

GRADATION

Term referring to the TONE scale or CONTRAST range of a developed image. An image which shows a large number of intermediate tones of gray between the extreme dark and light tones is said to have a Soft Gradation; if there are only a few recognizable shades of gray between the extreme dark and light tones, it is said to have a Hard Gradation.

Note: The Gradation of an emulsion is at once obvious from the steepness of its CHARACTERISTIC CURVE(S). An emulsion with a steep curve(s) will possess a harder gradation than one with a shallow curve(s).

GRADIENT [4]

Applied to the CHARACTERISTIC CURVE, the slope of any chosen part of the curve; distinguished from GAMMA which refers to the slope of the STRAIGHT-LINE portion of the curve only.

GRAIN

(1) One of the discrete silver particles resulting from the development of an exposed light-sensitive material.

(2) This term may also be used with color images, although the grain is really a DYE GLOBULE.

Note: Grains have definite edges where globules are translucent and, thus, appear different under high magnification.

GRAININESS (GRAINY)

The mealy appearance of the image caused by the clumping together of the silver grains or, in color transparencies, the clumping together of the GLOBULES.

GRAM (METRIC SYSTEM) [4]

The international unit of weight. It is the weight of a cubic centimeter of pure water at its maximum density. It is equal to 15.432 grains AVOIRDUPOIS.

GRANULARITY

A term referring to the granular structure of the sensitive emulsion as represented by the measured variation in the distribution of an apparently uniform silver or DYE GLOBULE deposit.

Note: It is a scientific concept whereas GRAININESS is a subjective visual impression created by the granular structure of a photographed material.

GRASSMANN'S LAWS

The laws of ADDITIVE COLOR MIXTURE as stated by Grassmann in 1855 and serving as a basis for the science of COLORIMETRY. Of these laws the most important are (a) lights of the same color produce identical effects in mixtures regardless of their spectral composition; (b) two lights of the same color, added to two other lights of the same color, produce mixtures that likewise have the same colors; (c) two lights of the same color, each subtracted respectively from mixtures of equal color, leave remainders that color-match; and, (d) if one component of a two-component mixture is steadily changed (while the other remains constant), the color of the mixture steadily changes.

GRAY [5]

An ACHROMATIC COLOR of any lightness intermediate between the extremes of black and white.

GRAY SCALE [4]

A series of ACHROMATIC COLORS ranging from white to black with intermediate tones of gray.

See Also: STEP WEDGE; WEDGE

GREEN [5]

(1) The hue attribute of visual sensations typically evoked by stimulation of the approximately normal retina with radiation of wavelength 513 nm.

(2) Any hue predominantly similar to GREEN.

(3) The complement of MAGENTA or PURPLE.

GREEN-BLINDNESS

See DEUTERANOPIA

GREEN FILM [4]

Newly developed film which, although apparently dry, still contains a considerable amount of moisture. Even in a warm room film does not become completely dry in less than 6 to 12 hours, and it is best not to attempt printing or enlargement of film sooner than this.

GROUND [5]

(1) The focused or unfocused surroundings of a figure or object perceived as lying beyond and not belonging to the figure or object.

(2) The earth as seen on high-altitude imagery.

H

H. & D. CURVE [4]

(1) A Hurter and Driffield graph showing the relationship of exposure and density where the density is plotted against the logarithm of the exposure.

(2) See CHARACTERISTIC CURVE

HALATION [4]

A fault of film in which the highlights are blurred and encroach upon the surrounding shadows. It is caused by the scattering of light by the silver halide crystals and by the reflection of the film on the back of the camera platen.

Note: On color films, bright colors of highlight areas may appear smeared.

HARDENING BATH (HARDENER)

A solution used to harden the gelatin on the emulsion.

HARDENING FIXER [8]

Fixing bath, particularly one for fixing negatives, that contains a hardener so that the emulsion is hardened and rendered less liable to injury in subsequent washing, drying, and handling.

HARDENING STOP BATH [11]

A HARDENING BATH that also contains an acid to arrest the progress of development. It is used after DEVELOPMENT and before FIXING.

HARDNESS [4]

In negatives and prints too much Contrast; too great a difference between lights and shadows; too steep a GRADATION.

HARDY-RAND-RITTLER PSEUDO-ISOCHROMATIC PLATE TEST

A test to distinguish types and degrees of red-green and yellow-blue color deficiencies. It uses simple designs in colored dots on colored dot backgrounds and has been used with children, foreigners, and illiterates.

HAZE

The suspension of moisture, dust, and other matter in the atmosphere which scatters ultraviolet, violet, and blue wavelengths of light. Longer wavelengths of light, such as red, are less affected.

Note: Haze causes high-altitude and oblique color images to have a bluish overcast, reducing color fidelity and balance.

See Also: FILTER, HAZE; RAYLIEGH SCATTERING; MIE SCATTERING

HEIGHTEN [5]

To heighten a color is to increase its intensity.

HERING GRAYS [5]

A set of 50 neutral gray papers graded from extreme white to extreme black in steps which approximate subjective equality. The set represents the ACHROMATIC series of colors.

HERING THEORY OF VISION [5]

The theory proposed by E. Hering and modified by later writers, according to which colors are due to three pairs of antagonistic processes in the optic system, one member of each pair being destructive, the other constructive, the pairs yielding respectively, white and black, yellow and blue, and red and green. Thus we see yellowish and bluish colors but not both at the same time (yellow cancels blue and vice-versa). Similarly we see reddish and greenish colors but never both at the same time (red cancels green and vice versa), etc.

Note: This theory predicts a form of yellow-blue blindness (TETARANOPIA) of which no uncomplicated case has ever been reported. Yet it fails to predict two of the chief types of DICHROMATIC VISION (PROTANOPIA and TRITANOPIA). See Table 2 in the Appendix.

See Also: HURVICH-JAMESON QUANTITATIVE OPPONENT COLORS THEORY

HETEROCHROMATIC

Colors which vary in both HUE and SATURATION.

HETEROCHROMATIC PHOTOMETRY

Measurement of the intensity of colored light sources using a PHOTOMETER.

HETEROCHROMIC [5]

Same as DICHROMATISM (definition 2) but can apply to samples having more than two shades as a function of change in concentration.

HIGHLIGHTS [4]

The densest parts of a negative and the lightest parts of a print or positive transparency.

HOLMGREN WOOL TEST

A test to separate color normals from green-red defectives which involves the matching of skeins of different-colored yarn with three standard skeins (red, green-yellow, and purple).

Note: The test has not been standardized in terms of the skein colors and detects only about half the color defectives examined [6].

HOMOCHROMATIC

A color of single HUE and SATURATION but can vary in BRIGHTNESS.

HOMOCHROMATIC AFTER-IMAGE [11]

See AFTER-IMAGE, POSITIVE

HORNER'S LAW [5]

A principle of the inheritance of color-blindness according to which the common types are transmitted from males to males through unaffected females (via a sex-linked recessive gene).

HUE [4]

(1) That attribute of a CHROMATIC COLOR by virtue of which it differs from gray of the same lightness and which allows it to be classed as red, yellow, green, blue, or intermediate mixes of these SPECTRAL COLORS.

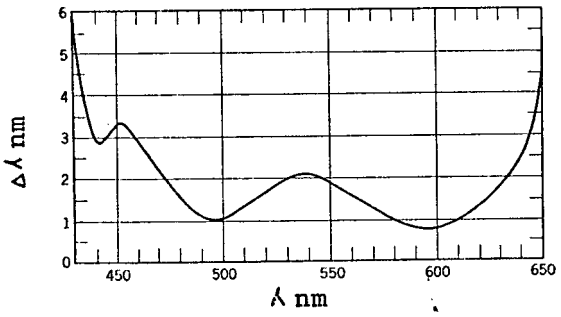
(2) A dimension in the MUNSELL COLOR SYSTEM of uniform perceptual steps in hue.

(3) Analogous to DOMINANT WAVELENGTH.

HUE THRESHOLD, DIFFERENTIAL

The just-perceived wavelength difference in Hues at constant purity and luminance (saturation and brightness) expressed in nanometers.

Note: Generally, .1 to .2 nm are required over most of the spectrum but up to .6 nm at the extremes. See the Figure below:



Differential color sensitivity throughout the spectrum, according to Wright and Pitt. Wright's colorimeter, free from diffused light, 2° field, average retinal illumination 70 trolands except in the extreme blue, method of limits. From LeGrand, Yves, Light, Colour and Vision, Fig. 73, p. 275. (Translated by R.W.G. Hunt, J.W.T. Walsh, and F.R.W. Hunt, New York; John Wiley & Sons, Inc., 1957.)

HURVICH-JAMESON QUANTITATIVE OPPONENT COLORS THEORY

A quantitative expression of the HERING THEORY OF VISION which has been the most successful in explaining quantitatively recorded facts of color vision.

Note: The criticisms of it are the same as the HERING THEORY OF VISION (which see). See Table 2 in the Appendix.

HYPERFOCAL DISTANCE [4]

If an object at a great distance (infinity) can be sharply focused, it is found that, without altering the position of the lens,

HYPERFOCAL DISTANCE [4]

a comparatively near object is still "in focus"; that is, it is rendered without perceptible unsharpness. The distance to this near point is the hyperfocal distance.

HYPERSENSITIZING [4]

A term applied to various methods of increasing the sensitivity and SPEED of an unexposed emulsion; for example, fuming or bathing with ammonia, fuming with mercury, etc.

I

ICI [5]

Abbreviation for the International Commission on Illumination.

Note: The French title of the ICI, Commission Internationale de l'Eclairage, and its abbreviation CIE is commonly used but rarely the German title (Internationale Beleuchtungs-Kommission) or its abbreviation IBK.

IDIORETINAL LIGHT

The light being sensed or perceived by the visual system when there is no external source of light. Caused by the continuous physiological activity of the visual system.

ILLUMINANCE [5]

LUMINOUS FLUX incident per unit area of surface.

Note: This quantity has commonly been called illumination in the past. Usual units are the LUX or LUMENS per square meter. See Figure 4 in the Appendix.

ILLUMINANCE, LAW OF

The principle that the ILLUMINANCE of a surface varies directly as the INTENSITY of the light source, inversely as the square of its distance, and directly as the cosine of the angle made by the light-rays with the perpendicular to the surface.

See Also: INVERSE SQUARE LAW

ILLUMINANT

In the CIE system, light defined by its SPECTRAL POWER DISTRIBUTION, in contrast to a source, which is a physically realizable object emitting RADIANT POWER.

ILLUMINANT COLOR [5]

Color seen as glowing, luminous, or belonging to light source, e.g., a colored light bulb.

ILLUMINANT-COLOR PERCEPTION [5]

Color perceived as belonging to a source of light.

ILLUMINANT, STANDARD

See STANDARD ILLUMINANT

ILLUMINATION

See ILLUMINANCE

ILLUMINATION COLOR [5]

Color seen as belonging to illumination distributed in space, e.g., color of sunlight in a room, red light flooding a stage, etc.

ILLUMINATION-COLOR PERCEPTION [5]

The awareness of the distribution of colored light in space.

IMAGE

The counterpart of a scene produced on film by the reflection

IMAGE (Continued)

or refraction of light when focused by a lens or mirror.

IMAGE, LATENT

An invisible image on exposed but undeveloped film or print that can be revealed by DEVELOPMENT.

IMAGE-MOTION COMPENSATOR (I.M.C.) [4]

A device installed with certain aerial cameras to compensate for the forward motion of an aircraft while photographing ground objects. True image-motion compensation must be introduced after the camera is oriented to the flight track of the aircraft and the camera is fully stabilized.

IMAGE, RETINAL

The optical image of an external scene focused upon the RETINA by the refracting surface (lens) of the eye.

IMBIBITION [5]

(1) A process for producing a dye-image by mechanical printing. A dyed relief or differentially tanned matrix of some substance such as gelatin is brought into intimate contact with a moist absorbing layer, the dye diffusing from the matrix to the absorbing layer.

(2) To absorb or assimilate moisture, gas, light, etc.

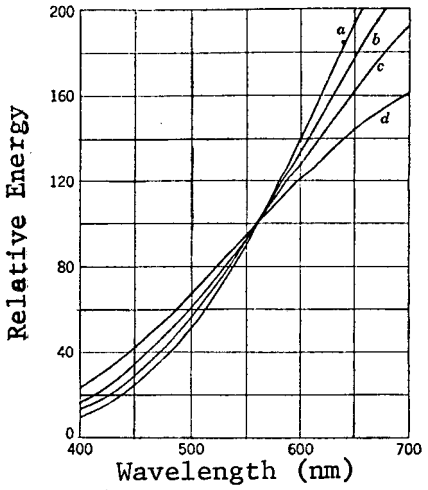
INCANDENSCENCE

The emission of light from a heated solid or liquid. Its SPECTRAL DISTRIBUTION or color is dependent on its temperature, e.g., a tungsten filament lamp.

INCANDESCENT TUNGSTEN LIGHT

Light emitted by a tungsten filament. Wavelength/relative power distribution varies with temperature of the filament.

Note: In the Figure below are spectral power distribution curves for (a) 25-Watt, (b) 50-Watt, (c) 500-Watt, and (d) 1000-Watt lamps.

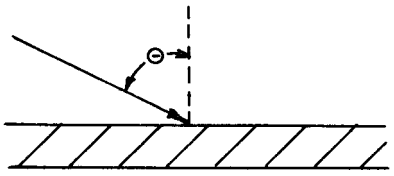


INCIDENCE, ANGLE OF [5]

The angle between the path of an oncoming ray of light and the normal to the surface on which it impinges.

Note: Angle θ is angle of incidence.

INCIDENCE, ANGLE OF [5] (Continued)



See Also: SNELL'S LAW

INCIDENT FLUX

The rate at which radiant energy strikes a surface.

INCOMPLETE RADIATOR

A RADIATOR that emits less power than a BLACKBODY at the same temperature.

INDEX OF REFRACTION

See REFRACTIVE INDEX

INDIRECT COLORIMETRY

The measurement of a color using indirect means.

Note: The color of a nonself-luminous object can be computed from its SPECTRAL REFLECTANCE (or transmittance), the SPECTRAL POWER DISTRIBUTION of the illuminant, and the CIE COLOR MATCHING FUNCTIONS for the spectrum. These calculations consist of summing the products of these three groups of data, wavelength by wavelength one complete calculation for each of the three PRIMARIES.

INDUCED COLOR

A color or change in color which appears in a given portion of the subjective visual field not caused by direct stimulation of the corresponding portion of the retina, but caused by the stimulation of the surrounding retina.

Note: Colors as perceived may be affected by adjacent colors. For example, yellow will appear darker in a black surround than in a gray surround. The darker yellow is the Induced Color.

See Also: SIMULTANEOUS COLOR CONTRAST

INDUCING COLOR

The color which affects the perceived appearance of an adjacent color.

Note: Distinguished from INDUCED COLOR, the color that causes the effect.

See Also: SIMULTANEOUS COLOR CONTRAST

INFINITY [4]

In photography, an indefinitely great distance; a distance so great that rays from a point source of light at that distance are parallel for all practical purposes. For most lenses and most types of work, any distance 1,000 times the focal length may be safely regarded as infinity.

INFRACHROMATIC

Term sometimes used to describe emulsions sensitive to infrared radiations, as used for infrared photography.

IR

Abbreviation for "INFRARED".

INFRARED (IR)

Pertaining to or designating the portion of the electromagnetic spectrum with wavelengths just beyond the red end of the visible spectrum, such as radiation emitted by a hot body. Their wavelengths are longer than those of visible light and shorter than those of radio waves. Light rays whose wavelength is greater than 700 nanometers. Invisible to the eye, infrared rays are detected by their thermal and photographic effects.

Note: There are films which are sensitive to the IR wavelengths which image in black and white and FALSE-COLOR. These films generally image live vegetation as a particular shade of color such that living vegetation can be detected easier and be distinguished from most other targets and backgrounds.

See Also: COLOR INFRARED FILM; BLACK AND WHITE INFRARED FILM

INSTRUMENTAL COLORIMETRY

The use of an instrument to determine the CIE TRISTIMULUS VALUES X, Y, AND Z for a given transparency or opaque sample. The two most frequently used instruments are the RECORDING SPECTROPHOTOMETER and the TRISTIMULUS COLORIMETER.

INSTRUMENTAL METAMERISM

See METAMERISM, INSTRUMENTAL; METAMERISM, GEOMETRIC

INTEGRAL DENSITOMETRY (INTEGRAL DENSITIES)

The measurement of integral densities. They are the result of the combined or net effect of the superimposed dyes in a color film with no attempt to separate the effects of a single dye from the total density. Four types of integral densities are commonly used: INTEGRAL SPECTRAL DENSITIES, PRINTING DENSITIES, COLORIMETRIC DENSITIES, and ARBITRARY THREE-FILTER DENSITIES.

See Also: (See above four densities)

INTEGRAL PRINTING DENSITIES

INTEGRAL DENSITIES measured by a DENSITOMETER whose response approximates the photographic response of the printing or duplicating material. These may also be calculated mathematically by using equations which take into account the characteristics of the duplicating material.

INTEGRAL SPECTRAL DENSITIES

The density measured, wavelength-by-wavelength, on all the fundamental dyes in a material.

INTEGRAL SPECTRAL DENSITIES (Cont'd)

A SPECTROPHOTOMETER or similar device capable of narrow-band, wavelength separations is required.

INTEGRATING SPHERE

An optical device used in a SPECTROPHOTOMETER to collect light reflected from an opaque sample.

INTENSITY, OF LIGHT

The amount of RADIANT ENERGY per unit area. The higher the amount, the greater the intensity.

See Also: ILLUMINANCE; LUMINANCE; CANDLE POWER.

INTERFERENCE [4]

An effect resulting from the meeting of two light rays of identical wavelength but different phase; when the phase difference is 1/2 wavelength, the two light waves cancel and darkness results; interference between two rays of HETEROCHROMATIC light results in colored patterns similar to the SPECTRUM produced by a PRISM.

INTERFERENCE COLORS [5]

Colors resulting from the destruction of the light of certain wavelengths and the augmentation of the light of others by INTERFERENCE.

INTERFERENCE FILTER

See FILTER, INTERFERENCE

INTER-IMAGE EFFECTS

The interaction, during processing, of the chemical reactions that are occuring in each of the emulsion layers of a multilayer film. For example, the chemical reaction that develops the magenta image may also cause some undesired development of the cyan image in the next emulsion layer.

Note: These interactions are generally taken into account and used as beneficial design characteristics.

INTERNAL REFLECTION

Reflection of light from the various glass surfaces of a compound lens. Such reflection cuts down the illumination passing through the compound lens.

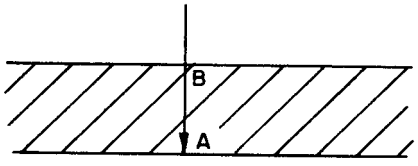
INTERNAL TRANSMITTANCE

See TRANSMITTANCE, INTERNAL

INTERNAL TRANSMISSION FACTOR [5]

The ratio of the LUMINOUS FLUX reaching the second surface of a transparent body to the luminous flux leaving the first surface.

Note: In the Figure below, the ratio of the flux at A to that at B.



INTERNATIONAL CANDLE

An international unit of light intensity (see CANDELA).

INTERPUPILLARY DISTANCE (INTEROCULAR DISTANCE) [12]

The distance between the pupils of the eye of an individual. The range is from 2.2 to 3.0 inches.

INTERVALOMETER [4]

A device used on aerial cameras which automatically operates the shutter at predetermined intervals.

INVARIABLE HUES [6]

Certain wavelengths produce hues which do not change as far out on the retina as saturation is elicited. These wavelengths are approximately 464 nm, 489 nm, and 571 nm.

INVARIANT HUES

The Invariant Hues are those which are independent of the BEZOLD-BRÜCKE phenomenon, i.e., those hues which do not change with a change in luminance of the stimulus. In general, the HUES correspond to the following wavelengths: 474 nm (blue), 506 nm (green), 571 nm (yellow), and a complementary wavelength of 495 nm (red).

See Also: BEZOLD-BRÜCKE PHENOMENON

INVARIANT MATCH

A COLOR MATCH which is agreed upon by all people under all illuminants.

INVERSE SQUARE LAW [4]

The illuminance of a unit surface and, consequently, the brightness of the surface vary inversely with the square of the distance from a point of light source.

See Also: ILLUMINANCE, LAW OF

IRIDESCENT [5]

Changing color with position. Usually applied to colors produced by INTERFERENCE, REFRACTION, or DIFFRACTION.

Note: Such as the rainbow of colors on a soap bubble or on an oil film on water.

IRIS

A part of the CILIARY BODY which has a central circular aperture called the PUPIL which is the APERTURE STOP of the eye.

Note: See Figure 1 in the Appendix.

IRIS DIAPHRAGM [4]

A lens control composed of a series of overlapping leaves operated by a revolving ring to vary the aperture of the lens.

IRRADIANCE

The RADIANT FLUX incident per unit area of a surface.

IRRADIANCE, SPECTRAL

The RADIANT FLUX per unit wavelength incident on a unit area of surface.

IRRADIATION

(1) The spreading of light in an emulsion caused by reflection from the surfaces of the silver halide crystals. The slight blurring caused by irradiation should not be confused with the more noticeable and extensive blurring known as HALATION which is caused by reflection from the back surface of the plate or film on which the emulsion is supported.

(2) The perceived spreading of brighter colors onto their darker surround which may slightly enlarge the perceived size of the brighter color.

(3) The process by which radiant energy is made to be incident upon a surface.

ISCC (INTER-SOCIETY COLOR COUNCIL) COLOR APTITUDE TEST

A test used to measure the ability to discriminate saturation differences and scored according to the accuracy of saturation matches. The examinee is instructed to match on a panel of 48 colored chips (involving 4 HUES, each with a set of chips varying in SATURATION) a colored chip he has drawn from an identical set of 48 colors. People can be sorted into five groups according to saturation discrimination: low, satisfactory, good, excellent, and exceptional.

ISCC-NBS(INTER-SOCIETY COLOR COUNCIL-NATIONAL BUREAU OF STANDARDS) COLOR DESIGNATION

Designation of a color by simple English words according to a method devised by the Inter-Society Color Council and worked out in detail at the National Bureau of Standards. The 267 color names used include a number of hue names plus the adjectives light, medium, dark, pale, grayish, blackish, moderate, brilliant, strong, deep, and vivid. These color names are related to specific regions in the MUNSELL COLOR SYSTEM.

ISHIHARA TEST

A test to distinguish green-red color deficiency from normal color vision. It is a PSEUDO-ISOCHROMATIC PLATE color test.

ISOCHROMATIC [4]

Of equal color.

ISOMERIC COLORS

Colors whose SPECTRAL DISTRIBUTIONS are the same and have identical TRISTIMULUS VALUES X, Y, and Z. Not a recommended term.

ISOMERIC PAIR

Two colors of identical SPECTRAL DISTRIBUTIONS and TRISTIMULUS VALUES X, Y, and Z. Not a recommended term.

ISOPAQUE CURVE [5]

A line connecting a series of points of equal opacity. Such curves when applied to spectrograms may be used to demonstrate the color sensitivity of photographic materials.

J

JUST-NOTICEABLE DIFFERENCE
(JUST-PERCEPTIBLE DIFFERENCE) [5]

The least difference in value between two compared stimuli which (in a given individual) gives rise to two different sensations 50% of the times presented. Abbreviated j.n.d.

Note: For example the j.n.d. of two spectral green colors is about 1 to 2 nanometers.

See Also: DIFFERENCE LIMEN

K

KELVIN (K)

A temperature scale starting at absolute zero (approximately -273 C) and having a degree of the same magnitude as those of the CELSIUS scale. Thus 0 C = 273 K; 100 C = 373 K. According to convention, the degree sign and the word degree are now omitted in all references to Kelvin temperatures.

See Also: ABSOLUTE TEMPERATURE

KILOWATT

1,000 watts.

KIRCHOFF'S LAW [5]

Ratio of RADIANT EMITTANCE to RADIANT ABSORPTANCE is the same for all surfaces at the same temperature.

KODACHROME [8]

Pioneer SUBTRACTIVE reversal process of color photography worked out by L. D. Mannes and L. Godowsky and introduced by Kodak in 1935. It makes use of an integral TRIPACK in which the emulsions contain no color formers but are subject to individual dye development.

KODACOLOR [8]

(1) Originally an additive method of producing color photographs with the aid of a lenticular screen embossed on the front of the film. It was first made available commercially in 1928 on 16 mm. cine film.

(2) The name is now applied to a negative-to-positive process for making positive color prints.

KODAK [8]

Trade name of USA Eastman Kodak Co., coined by George Eastman, founder of the organization, in 1888 and first registered in Great Britain on May 3, 1888, then in the United States on September 4, 1888, and subsequently in many other countries. It was first used in connection with Eastman's original box-type cameras. Eastman was determined to adopt a trademark that could not be misspelled or mispronounced in any language, or infringed or copied by anyone. He wanted a strong word that could be registered and that people would not forget.

KUBELKA-MUNK ANALYSIS

A two-flux turbid medium theory for describing the way light interacts with any medium which both scatters and absorbs it. Describes the reflectance and transmittance of translucent materials in terms of a scattering coefficient and an absorption coefficient K. In the limiting case of opaque materials,

$$\frac{K}{S} = \frac{(1-R)^2}{2R}$$

where R is the reflectance of the sample. For colored samples where R, K, and S depend upon the wavelength, the Kubelka-Munk

KUBELKA-MUNK ANALYSIS (Continued)

Analysis can be used to formulate the mixture of colorants (dyes or pigments) to produce a specified color. Works well for paints, plastics, paper textiles, and many other systems.

L

LADD-FRANKLIN THEORY OF COLOR VISION [5]

A theory which assumes that in the retinal nerve endings the respective light stimuli liberate red-, green-, and blue-stimulating substances from a complex photosensitive molecule and that red and green, when present, unite to form a yellow-stimulating substance. According to this theory, blue and green, or blue and red cannot unite so, and do not individually disappear in the respective blue-green and blue-red (or purple) mixtures. All colors are produced by various mixtures of these liberated substances.

Note: See Table 2 in the Appendix.

LAMBERT

The lambert is a unit of surface LUMINANCE equal to $1/\pi$ candela per square centimeter.

Note: See Table 1 in the Appendix.

See Also: FOOT-LAMBERT; METER-LAMBERT

LATENT IMAGE

See IMAGE, LATENT

LATERAL-CHROMATIC ABERRATION [4]

A lens aberration which affects the sharpness of images off the OPTICAL AXIS because different colors undergo different magnifications.

See Also: CHROMATIC ABERRATION

LATERAL GENICULATE BODY

See GENICULATE BODIES, LATERAL

LATERAL-OBLIQUE PHOTOGRAPH [12]

An oblique aerial photograph taken with the camera axis as nearly normal as possible to the flight line.

LATITUDE

See EXPOSURE LATITUDE

LEADER [12]

A strip of material at the beginning of a roll of film which is used to assist the threading of the film through the camera and processing equipment.

LENS

(1) A transparent object (usually made of glass, fluorite, or quartz) having two polished surfaces of which at least one is curved. It is shaped so that the rays of light when passing through it are made to converge or diverge.

(2) See CRYSTALLINE LENS

LENS ELEMENT [12]

One lens of a complex lens system. In a photographic lens, the terms front element and rear element are often used.

LEUCO-BASE

A white or slightly colored substance which upon oxidation (sometimes accompanied by reaction with an acid or base) yields a more highly colored dye.

LIGHT [1]

(1) The aspect of RADIANT ENERGY or the portion of the ELECTROMAGNETIC SPECTRUM of which a human observer is aware through the visual sensations that arise from the stimulation of the RETINA of the eye.

(2) Used in reference to colors having brightness values near white, such as light red, light blue, etc.

(3) Diffusely reflecting a relatively large amount of the incident light.

(4) The opposite of dark.

LIGHT ADAPTATION

See ADAPTATION, LIGHT

LIGHT-ADAPTED EYE [5]

An eye which has been exposed to light stimuli of relatively high intensity and therefore has become relatively insensitive to lower intensities.

Note: For judging or naming color light-adapted eyes are necessary because color perception is absent in the dark-adapted eye.

See Also: ADAPTATION, LIGHT; PHOTOPIC VISION

LIGHT WAVES

Light when regarded as an undulatory or wave-like phenomenon.

LIGHTNESS

(1) The attribute which permits a surface color (CHROMATIC or ACHROMATIC) to be classified as equivalent to some member of the series of grays ranging from black to white.

(2) The attribute of color perception by means of which an object is judged to reflect light rather than another object.

LIMEN

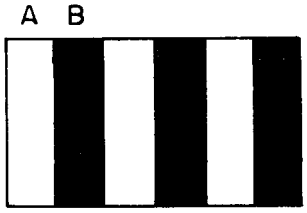
Same as THRESHOLD

See Also: DIFFERENCE LIMEN

LINE PAIR

In resolution targets, the width of one line and one space in a parallel line target. Normally the line-width and space-width are equal.

Note: In the Figure below, A and B form a line pair.



LIVID COLOR [5]

A leaden tint (blue, violet, or green) approaching black.

LOCI OF CONSTANT HUE [18]

Curves on the CHROMATICITY DIAGRAM representing colors that have same hue under prescribed conditions.

LOCI OF CONSTANT SATURATION [18]

Curves on the CHROMATICITY DIAGRAM representing colors that have same saturation under prescribed conditions.

LOGARITHM (LOG) [4]

The exponent that indicates the power to which a fixed number must be raised to obtain a given number. Logarithms to the base 10 are frequently used; for example, the log of 1,000 is 3 since $10^3 = 1{,}000$.

LONGITUDINAL CHROMATIC ABERRATION [4]

An aberration which affects the sharpness of all parts of an image because different colors come to a focus at different distances from the lens.

See Also: CHROMATIC ABERRATION

LOVIBOND COLOR SYSTEM

A system based on the use of 3 sets of transparent glasses, red, blue, and yellow (actually magenta, cyan, and yellow). The glasses within each set vary in optical density and are designated numerically (1R, 2R, 1B, 2B, 1Y, 2Y, etc.) so that the numbers are additive (1B+2B = 3B, etc.) and any combination with equal numerical values of all three colors yields a neutral (achromatic) color. By combining these glasses properly most colors can be matched. For example, a red color might be matched by combining glasses 1R and 2Y. This red would be designated as 1R + 2Y. These Lovibond glasses are used in a Lovibond Tintometer (Colorimeter) in which the glasses are placed in half the field of view and the color sample in the other half. One changes the glasses until a visual match is obtained.

LOVIBOND COLORIMETER

See LOVIBOND COLOR SYSTEM

LOVIBOND NUMBERS

Numbers proportional to the densities of three glass colorants (a yellow, a red, and a blue) required to modify a standard light source to produce a color match.

See Also: LOVIBOND COLOR SYSTEM

LOVIBOND TINTOMETER

See LOVIBOND COLOR SYSTEM

LUMEN

The LUMINOUS FLUX per unit SOLID ANGLE from a point source whose intensity is one CANDELA.

LUMINANCE

The luminous intensity of any surface in a given direction per unit of projected area of the surface as viewed from that direction.

Note: The unit is the candela per square meter. See Figure 4.

LUMINANCE FACTOR

The ratio of the LUMINANCE of a body to that of a perfect reflecting diffuser identically illuminated.

LUMINANCE PURITY

See COLORIMETRIC PURITY

LUMINESCENCE [8]

Visible glow of certain substances when subjected to stimulation by electromagnetic radiation, electric fields, or heat. The general term luminescence also embraces phenomena such as electroluminescence, fluorescence, and phosphorescence.

LUMINOSITY

A measure of the visibility or brightness-producing capacity of light consisting of the ratio of photometric quantity to corresponding radiometric quantity.

LUMINOSITY COEFFICIENTS

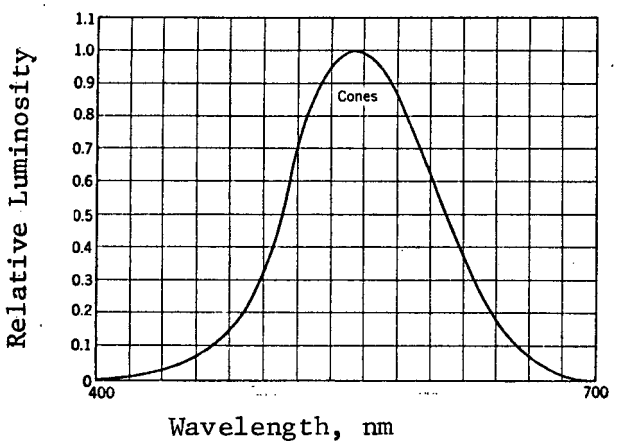
The coefficients by which the COLOR-MIXTURE DATA for any color need be multiplied so that the sum of the three products is the LUMINANCE of the color.

Note: For a single set of primaries and a single observer these coefficients are the same for all sample colors and may be interpreted as the luminosities of the primaries. For the CIE 1931 2° STANDARD OBSERVER and primaries, these coefficients are 0, 1, 0, all luminosity being associated with the tristimulus value Y.

LUMINOSITY CURVE (PHOTOPIC CURVE, VISIBILITY CURVE, LUMINOSITY FUNCTION)

Curve of the relative LUMINOSITY of the visual spectrum plotted as a function of wavelength.

Note: In the figure below, the photopic luminosity curve of the human eye is presented.



LUMINOSITY FACTOR (K)

The Luminosity Factor for radiation of a particular wavelength is the ratio of the LUMINOUS FLUX at that wavelength to the corresponding RADIANT FLUX. It is expressed in lumens per watt.

Note: $K = F_\lambda/\phi_\lambda$

where: F = LUMINOUS FLUX
ϕ = RADIANT FLUX
λ = WAVELENGTH

LUMINOUS [5]

Characteristic of the illuminant mode of appearance; glowing, having the appearance of emitting light.

LUMINOUS DENSITY [5]

Luminous energy contained in a unit volume of space.

See VISUAL DENSITY

LUMINOUS DIRECTIONAL REFLECTANCE

The LUMINOUS REFLECTANCE that a perfectly diffusing surface would have to possess in order to appear as bright as the object in question under the same illuminating and viewing conditions.

LUMINOUS DIRECTIONAL TRANSMITTANCE

The ratio of the LUMINANCE of the second surface of a light-transmitting specimen to the illuminance of the first surface.

LUMINOUS EFFICIENCY [5]

The Luminous Efficiency of RADIANT ENERGY is the ratio of the LUMINOUS FLUX to the RADIANT FLUX.

Note: Luminous Efficiency is usually expressed in lumens per watt of radiant flux. It should not be confused with the term efficiency as applied to a practical source of light since the latter is based upon the power supplied to the source instead of the radiant flux from the source. For energy radiated at a single wavelength, Luminous Efficiency is synonymous with LUMINOSITY FACTOR.

LUMINOUS EMITTANCE [5]

The LUMINOUS FLUX being radiated from a unit area of a primary or secondary source (lumens per unit area).

LUMINOUS ENERGY [5]

Evaluation of RADIANT ENERGY according to its stimulation of the brightness attribute of visual perception.

LUMINOUS FLUX

The flow rate of LUMINOUS ENERGY expressed in LUMENS.

Note: See Figure 4 in the Appendix.

LUMINOUS INTENSITY [5]

LUMINOUS FLUX emitted per unit solid angle about a source. The unit is the CANDELA.

Note: See Figure 4 in the Appendix.

See Also: CANDELA

LUMINOUS REFLECTANCE [5]

Ratio of reflected to incident LUMINOUS FLUX.

LUMINOUS TRANSMITTANCE [5]

Ratio of transmitted to incident LUMINOUS FLUX.

LUSTER [5]

The appearance of a surface which results from its mirror-like reflection.

LUX

A unit of ILLUMINANCE equivalent to one lumen of incident light per square meter.

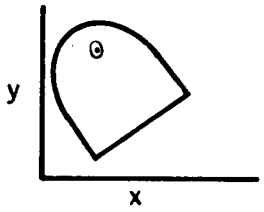
Note: See Figure 4, and Table 1 in the Appendix.

M

MACADAM ELLIPSES

Elliptical shaped figures on a CIE CHROMATICITY DIAGRAM joined by the locus of points that correspond to colors that are, visually, equally different from the color at the center of the ellipse.

Note: MacAdam Ellipses are equally different perceptually from the color (the dot) at the center.



MACULA (MACULA LUTEA; MACULAR AREA; YELLOW SPOT) [5]

A yellow pigmented area in the RETINA of irregular shape and variable from one individual to another. The FOVEA is found in the Macula.

MAGAZINE

A container for rolled film or photographic plates attached to the camera body and usually equipped with automatic mechanisms that advance and position the photographic material for exposure.

MAGENTA (MINUS-GREEN)

(1) The purple hue attribute of vision sensations typically evoked by stimulation of the normal human eye with a wavelength combination which is the approximate COMPLEMENT of 515 nanometers (or green).

(2) The COMPLEMENT of GREEN.

MAGENTA DYE

During the processing of color films it is the red-blue dye formed in the green sensitive layer.

Note: In positive transparencies it is formed where green wavelengths were not imaged, thus stopping the transmission of green except where it was imaged. In negative transparencies it is formed where green wavelengths were imaged, thus allowing its complement (MAGENTA) to be transmitted.

See also: CYAN DYE; YELLOW DYE

MACH BANDS

The bands perceived on either side of an edge between a light and dark area due to the brightness differences. The bands are perceived parallel to the edge and on the light side the band is seen as lighter and on the dark side, darker.

Note: Mach bands are often difficult to see and may cause misjudgment in choosing the position of an edge or its midpoint since it has been shown that people tend to choose closer to the dark band.

MAERZ AND PAUL, DICTIONARY OF COLORS

A dictionary containing 7056 different printed colors mixed from eight basic colors and seven gray pigments. The dictionary also contains 4000 color names for designating some of the printed colors.

MASKING

Essentially a mask is an image (black and white or single-colored) of the original to be copied which, when placed in registry with the original, affects the final copy in some way. In color reproduction masks are used to improve color balance and fidelity by correcting brightness and saturation errors.

Note: Practically speaking, the effect of a single mask is to lighten the reproduction of all colors complementary to the color of the filter used in making the mask. The mask also reduces the contrast of the original and thereby permits a higher printing contrast which increases the saturation of all colors. For example, a magenta filter absorbs green light and thus allows less exposure in the picture than it does through the other colors. When the mask has been developed and registered with the transparency, the greens are effectively lightened in relation to the other colors. Similarly, a mask exposed with a red filter, which absorbs both blue and green light, lightens both the blues and greens. regardless of the color of light used to expose it, a single mask used in exposing all three color-separation negatives can accomplish no hue-shift correction. With two masks, however, it is possible to correct not only the relative brightness and saturation errors but also the most serious hue-shift errors.

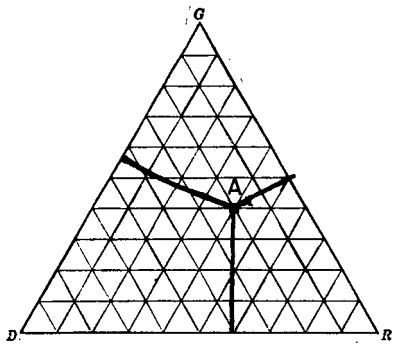
MATCH

See COLOR MATCH; INVARIANT MATCH; CONDITIONAL MATCH

MAXWELL TRIANGLE

The equilateral triangle in which the primaries are represented at the vertices and other colors that can be formed by the primaries fall in specific places in between.

Note: In the figure below is an example. A color is calculated by determining the distance it falls from the sides opposite the apexes. Thus Color A may be calculated as 2 units of blue, 4 red, and 4 green.



MEDIUM

Intermediate in value or lightness; between light and dark.

MEMORY COLOR [5]

Color, as remembered, of an object, film, or illumination. The memory colors of an individual exert influence in the determination of the colors of the familiar objects which he perceives.

Note: Memory of colors is not reliable. Generally memory colors emphasize dominant aspects of the true colors, e.g., reds are redder, dark-reds are darker and redder, etc.

MERCURY HYPERSENSITIZING [4]

A method of hypersensitizing (increasing the sensitivity) consisting of placing a globule of mercury in the film container. The mercury vapor will penetrate the film wrappings and exert its hypersensitizing effect. Generally results in a greatly increased log e level.

MESOPIC VISION (TWILIGHT VISION) [5]

Vision intermediate between PHOTOPIC and SCOTOPIC VISION and consequently attributed to the combined functioning of the RODS and CONES.

METALLIC COLOR [5]

Color typically evoked by selective reflection from certain metallic and other surfaces which possess the physical feature known as metallic reflection and which exhibits chromatic highlights similar in HUE to the surface as a whole. Metallic gold, silver, copper, bronze, chromium, and aluminum are examples.

METAMERIC COLORS

Colors which have different SPECTRAL DISTRIBUTIONS but appear to be identical colors under certain illuminants or to certain observers.

Note: According to most experts, metameric colors should not appear on color transparencies.

METAMERIC PAIR

Any two metameric colors.

METAMERISM

The phenomenon in which two colors are perceived as matching in spite of spectral differences. Also, the phenomenon of METAMERIC COLORS.

METAMERISM, GEOMETRIC

The phenomenon in which two colors are perceived as matching when observed at some sets of illuminating and viewing angles but not at other sets.

Note: Generally due to differences between the color materials, e.g., texture, thickness, distribution of colorants, etc.

METAMERISM, INSTRUMENTAL

The phenomenon in which two colors with different spectral curves have the same color coordinates when measured on one or more instruments but different coordinates when measured on other instruments.

METER-CANDLE

Same as LUX.

METER-CANDLE-SECOND

A unit of exposure in SENSITOMETRY; one second of exposure at a distance of one meter from a light source of one CANDELA.

METER-LAMBERT (APOSTILB)

A unit of LUMINANCE equal to $\frac{1}{\pi}$ candela/meter^2.

Note: See Table 1 in the Appendix.

METHUIN COLOR ATLAS

A collection of 1,266 printed colors arranged in orderly fashion with names for many of them. Not a highly systematic collection. In the United States, the REINHOLD COLOR ATLAS is the same.

METRIC SYSTEM [4]

A system of weights and measures (based on the decimal system) which is the international standard for scientific use. The meter, the liter, and the gram are the units of measures of length, capacity, and weight, respectively.

MICRODENSITOMETER [4]

A special form of DENSITOMETER for measuring densities in very small areas and used for measuring edge gradients on imagery and granularity of films.

MICROMETER

A unit of length in the metric system; the thousandth part of a millimeter or 10,000 Ångstrom units. The standard abbreviation for micrometer is μm. Formerly called the MICRON.

MICRON

Obsolete term for the MICROMETER.

MICRO-RECIPROCAL DEGREE [5]

Unit of RECIPROCAL COLOR TEMPERATURE obtained when one million is divided by the temperature in Kelvin. Abbreviated mired or μrd.

MIE SCATTERING

The selective scattering of wavelengths of light caused by particles and molecules in the atmosphere having approximately the same size as the wavelength of the incident light.

See also: RAYLEIGH SCATTERING

MILLIMETER

A unit length; 1/1,000 of a meter; mm is the standard abbreviation for millimeter.

MIL

1/1,000 of an inch.

MILLIMICRON

Obsolete term for NANOMETER.

MINUS-BLUE FILTER

A yellow filter which will not transmit blue wavelengths.

Note: Generally used over an aerial camera lens to reduce the transmission of predominant blue wavelengths caused by ATMOSPHERIC SCATTERING.

See also: FILTERS, HAZE

MINUS COLOR

A COMPLEMENTARY color. For example, minus-blue is complementary to blue.

Note: A Minus-color filter is one which will not allow that color to pass through. Thus, a yellow filter is a minus-blue filter because blue is not transmitted. From above definitions, yellow or minus-blue is complementary to blue.

MIST

Particles of water vapor suspended in the atmosphere. These particles tend to scatter blue light more than red light. The result is called ATMOSPHERIC SCATTERING and causes a bluish-cast on high-altitude imagery.

Note: HAZE FILTERS (MINUS-BLUE FILTERS) are used over aerial camera lenses to reduce the transmission of the blue wavelengths and thus reduce the effect on the imagery.

MIXTURE, LIGHT

Superimposition of two or more lights.

MODE OF APPEARANCE

Characterization of a color according to whether it is perceived to belong to an aperture, a surface, a volume, an illuminant, etc.

Note: Color transparencies are said to have "Film Color" as a MODE OF APPEARANCE.

MONOCHROMATIC [4]

(1) Containing light of one color.

(2) A scene composed of nearly the same color.

(3) Containing light of a single WAVELENGTH.

MONOCHROMATIC VISION

Vision in which no HUES or SATURATIONS are seen. Only brightness differences are perceived. The individuals are called Monochromats.

MONOCHROMATOR

A device that can be used to separate or select a single wavelength from any portion of the SPECTRUM of the source.

MONOCULAR VISION

Vision resulting when using only one eye.

MOTION FRINGE

A fringe of color occurring at the edge of moving images when the ADDITIVE COLOR SEPARATIONS are taken at different instants in time.

MOTTLED [5]

Unevenly colored; variegated; mealy, spotted.

MOTTLING [4]

Marks in the form of density variation which often appear on negatives or prints caused by insufficient agitation of the developer.

MULTIDIRECTIONAL ILLUMINATION [5]

Multidirectional illumination on a surface is produced by several separated light sources of a relatively small area. It is characterized by the fact that a small opaque object placed near the illuminated surface casts several shadows.

MULTILAYER FILM

A film coated with two or more layers of emulsion of differing characteristics; these include

MULTILAYER FILM (Continued)

double-coated films for reduction of HALATION effects and 2- or 3-layer films for color photography.

MULTISPECTRAL PHOTOGRAPHY (SPECTRAZONAL)

The simultaneous imaging of several SPECTRAL BANDS; each band on a separate film or emulsion layer.

Note: Generally, several (up to nine have been noted) cameras are mounted on the same platform, each with a panchromatic film and each with a different filter. Each film will then image a different range of wavelengths of the same scene. Color films are in a sense Multispectral because each emulsion layer is sensitive to a different range of wavelengths.

MUNSELL BOOK NOTATION

Munsell color notation as applied to the hue, value, and chroma scales of the samples of the MUNSELL BOOK OF COLOR. Currently, Munsell Book Notation is identical with MUNSELL RENOTATION but this was not true before 1943.

MUNSELL BOOK OF COLOR

Collections (matte and glossy) with an orderly arrangement of a series of colored chips. It is three-dimensional in nature with the vertical axis

representing black to white (10 shades) and called VALUE; the radial axis represents increasing amounts of color from the center outward and is called CHROMA; colors of the different HUES (40 are represented) surround the vertical axis. The book contains about 1,000 color samples (both CHROMATIC and ACHROMATIC); each adjacent sample being as perceptually different as the next adjacent sample. Each sample color is specified by a letter-number system of notation with respect to MUNSELL HUE, MUNSELL VALUE, AND MUNSELL CHROMA.

See also: MUNSELL NOTATION

MUNSELL CHROMA [5]

(1) Expression of the degree of departure of an object color from the ACHROMATIC color of the same lightness or Munsell Value.

(2) Analogous to Saturation.

Note: The Munsell Chroma scales have approximately uniform perceptual steps; under ordinary observing conditions Munsell Chroma of a specimen correlates well with the saturation of the color perceived to belong to the specimen.

See also: MUNSELL HUE; MUNSELL VALUE

MUNSELL COLOR SYSTEM

The coordinate system comprising MUNSELL HUE, VALUE, and CHROMA. It is three-dimensional in nature and is often arranged as described

MUNSELL COLOR SYSTEM (Continued)

for the samples of the MUNSELL BOOK OF COLOR. The Munsell Color System, however, is a notation system which is and can be used independent of any set of samples.

MUNSELL HUE

HUE in the Munsell Color System. See HUE.

MUNSELL NOTATION

Color specification in terms of MUNSELL HUE, MUNSELL VALUE, and MUNSELL CHROMA, written in the form of H V/C, e.g., 5R 4/10.

MUNSELL RENOTATION

Munsell color notation applied to HUE, VALUE, and CHROMA scales in accordance with the recommendations made in 1943 of the OSA Subcommittee (of the Colorimetry Committee) on the Spacing of the Munsell Colors. The original notations by Munsell were changed to more nearly reflect perceptual differences.

MUNSELL VALUE [5]

(1) Expression of the LUMINOUS REFLECTANCE of an object color on a scale giving approximately uniform perceptual steps under usual conditions of observation.

(2) Analogous to Lightness

Note: Munsell Value of an opaque surface may be found approximately by taking the cube root of the LUMINOUS REFLECTANCE according to the equation $V = 25\ Y^{1/3} - 17$ where V is Munsell Value and Y is luminous reflectance expressed on a scale so that Y = 100 for white. Under usual conditions of observation, the Munsell value of a specimen correlates closely with the lightness of the color perceived to belong to the specimen.

N

NADIR [4]

PHOTOGRAPHIC NADIR (PHOTOGRAMMETRY): the point at which a vertical line through the perspective center of the camera lens strikes the plane of the photograph. Also referred to as the nadir point. GROUND NADIR: the point on the ground vertically beneath the perspective center of the camera lens. MAP NADIR: the map position for the ground nadir.

NAGEL ANOMALOSCOPE [18]

Color vision test in which the observer determines relative amounts of red and green necessary to match spectral yellow.

NANOMETER (nm)

A unit of length in the metric system; the billionth (10^{-9}) part of a meter, or thousandth part of a micrometer, or 10 Ångstroms. Formerly called the millimicron. Customarily used to express the wavelength of visible light, e.g., 400-700 nm.

NEUTRAL DENSITY FILTER

See FILTER, NEUTRAL DENSITY.

NEGATIVE

A photographic image on film, plate, or paper, in which the ACHROMATIC or CHROMATIC colors to which the emulsion is sensitive are reversed or COMPLEMENTARY, respectively.

NEGATIVE COMPONENT IN COLOR MIXTURE [18]

Component or primary color that is mixed with the sample light in order to change it sufficiently to obtain a match with a mixture of the other two components (or primaries).

NEW LONDON NAVY LANTERN TEST [6]

A test of color vision used to screen out the more severe DICHROMATIC defective (red-green color defects). It uses back-lighted red, green, and neutral filters in pairs. The individual is asked to simply name the colors of the pairs. The test lights seen are very small simulating distant signal lights.

NEUTRAL COLOR

An ACHROMATIC COLOR falling between black and white; a gray.

NEUTRAL DENSITY WEDGE

A strip of different NEUTRAL DENSITY FILTERS in discrete steps or continuous tones.

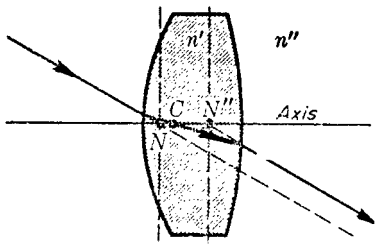
NM (NANOMETER)

See NANOMETER (nm)

NODAL POINT [4]

One of two points on the OPTICAL AXIS of a lens (or a system of lenses) such that, when all object distances are measured from one point and all image distances are measured from the other.

Note: In the Figure below, the ray emergent from the second point (N") is parallel to the ray incident at the first (N). The first nodal point (N) is also referred to as the front nodal point or incident nodal point and the second point (N") as the rear nodal point or emergent nodal point. Also called "node", front node, or rear node.



NODAL PLANE [4]

The plane perpendicular to the optical axis at a NODAL POINT.

NONCURLING [4]

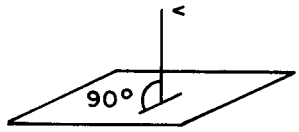
A term applied to film which has a clear gelatin coating on the back to minimize curl caused by shrinkage of the emulsion in drying.

NORMAL [5]

(1) In optics, the perpendicular to a surface at the point where a ray of light is incident upon a surface.

(2) Free of visual defects.

Note: In the Figure below, line A is the normal to the surface.



NORMAL COLOR VISION

See NORMAL TRICHROMATIC VISION

NORMAL TRICHROMATIC VISION (NORMAL TRICHROMAT)

A phrase meaning normal color vision. The term trichromatic means here that the normal observer needs 3 primary colors (blue, green, and red) to mix and match all the colors he can perceive.

NON-SELECTIVE FILTER

See FILTER, NEUTRAL DENSITY

NON-SPECTRAL COLORS

(1) Colors not found in the SPECTRUM.

(2) Mixtures of 2 or more wavelengths of light. Purple is an example as it represents a mixture of red and blue light.

O

OBJECT COLOR [5]

Color seen as belonging to an object. This includes surface and volume colors to the extent that surfaces and volumes are perceived as objects or parts of objects.

Note: In a strict sense, it is not legitimate to attribute a color to an object but only to the light emanating from it as perceived by an observer. The capacity of an object to modify the color of the light incident upon it corresponds to the common concept of the color of the object. Object colors are relatively insensitive to changes in viewing conditions, viz., they exhibit the phenomenon of COLOR CONSTANCY. In addition, objects tend to be related to particular colors, e.g., red apples, blue violets, etc. Thus the perception of an object's color may be influenced by previous experience with the object.

OBJECT-COLOR PERCEPTION [5]

Color perceived as belonging to a non-self-luminous object.

See Also: OBJECT COLOR

OBLIQUE PHOTOGRAPH [4]

A photograph taken with the camera axis intentionally directed between the horizontal and the vertical. High-oblique photograph: an oblique photograph in which the apparent horizon is included within the field-of-view; low oblique does not include the horizon.

OBSERVER METAMERISM

The phenomenon in which observers differ in their judgment as to whether METAMERIC COLORS do or do not match.

See Also: METAMERISM

OCCIPITAL CORTEX

Areas located on both sides of the rear portion of the brain which are the anatomical end of the OPTIC NERVES.

OCULAR DOMINANCE

The dominance of the perceptions of one eye over the other.

Note: When viewing two colors, one with each eye, one color may dominate in the field of view because of OCULAR DOMINANCE.

OLIVE [5]

Any color which manifests a hue predominantly similar to that of olive, dark-greenish yellow, a mixture of yellow, green, and black. (The complement of bluish-purple).

OPACITY

(1) The degree of obstruction to the transmission of visible light.

(2) Ratio of the measured reflectance of the sample to the reflectance measured with the sample over a white background, the white background having a reflectance of 89%.

OPPONENT-COLORS THEORY

Any doctrine to the effect that color vision can be explained on the basis of three pairs of opposing colors such as a red whose negative is green, a blue whose negative is yellow, and a white whose negative is black.

See Also: HERING COLOR THEORY; HURVICH-JAMESON COLOR THEORY

OPTIC CHIASMA

The neural junction where the two OPTIC NERVES join and then separate. It is at this point where all nerve fibers from the right half of both retinas (left field of vision) join, leave the chiasm, and go to the left GENICULATE BODY while the nerves of the left half of both retinas (right field of vision) join and go to the right GENICULATE BODY.

OPTIC DISC (BLIND SPOT)

An area of the Retina where the optic nerve is formed and leaves the retina. Contains neither rods nor cones and thus is a true blind area of the retina.

Note: See Figure 1 in the Appendix. Generally, people are not aware of this blind area because the eyes continually move and one eye sees the area blind to the other.

OPTIC NERVE

A bundle of elongated axons of the GANGLION CELLS which passes the visual information to the GENICULATE BODY.

OPTIC RADIATIONS

Nerves which carry the visual information from the GENICULATE BODY to the OCCIPITAL CORTEX.

OPTIC TRACKS

The term for the two OPTIC NERVES after they have left the OPTIC CHIASMA. They differ from the nerves in that each contains information from half (left or right) the field-of-view.

OPTICAL AXIS (PRINCIPAL AXIS) [4]

In a lens element, the straight line which passes through the centers of curvature of the lens surfaces. In an optical system, the line formed by the coinciding principal axes of the series of optical elements.

OPTICAL CENTER [4]

The point, usually within a lens, at which the light rays are assumed to cross.

OPTICAL DENSITY (D)

The logarithm of the reciprocal of the TRANSMITTANCE of a medium.

See Also: ABSORBANCE

OPTICAL SCATTERING

See SCATTERING

OPTICAL WEDGE

A device consisting of a strip of material--glass, celluloid or plastic--covered with a pigment or developed silver emulsion layer which is clear at one end and gradually becomes opaque towards the other. The transition from transparent to opaque may take place smoothly (continuous wedge) or in regular steps, in which case it is called a STEP WEDGE.

Note: Generally used as a comparison device in determining the DENSITY or OPACITY of a transparent area.

See Also: WEDGE

ORA SERRATA [6]

A thin irregular margin of the RETINA that represents the anatomical limit of the receptor system.

Note: See Figure 1 in the Appendix.

ORANGE

The hue attribute of visual sensations typically evoked by stimulation of the normal retina with radiation of wavelengths of approximately 592 nanometers.

ORTHOCHROMATIC [5]

(1) Characterizing the equivalence between the photographic effect of various colors upon a photographic material and the physiological effect upon the eye.

(2) By old usage, characterizing a photographic material sensitive to all colors except red.

ORTHOCHROMATIC EMULSION [5]

A photographic emulsion which is sensitive to yellow, green, blue, and shorter wavelengths, but not to orange or red.

ORTHOPANCHROMATIC [8]

Term used to describe materials sensitized to all colors of the visible spectrum that have an evenly balanced red sensitivity. In this they differ from the excessive red sensitivity of some high-speed panchromatic emulsions which are produced to give speed as a first consideration.

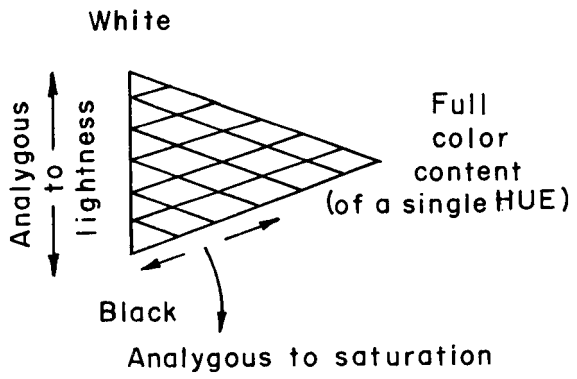
OSTWALD COLOR SYSTEM

A color system used to designate colors by their COLOR CONTENT; WHITE CONTENT, and BLACK CONTENT. Also based on the concept that color content + white content + black content = 1. There are 24 HUES. Each hue is described by 36 shades (colors) developed by adding white and black (called shading or toning) to the HUE. Each hue and its 36 shades are described on an OSTWALD COLOR TRIANGLE. (There are 24 such triangles, one for each hue).

OSTWALD COLOR TRIANGLE

The arrangement of colors of constant OSTWALD HUE in a triangle showing the Hue's FULL COLOR CONTENT, WHITE CONTENT, AND BLACK CONTENT. There are 24 such triangles.

Note: The Figure below shows an Ostwald Color Triangle.



OSTWALD COLORS [5]

A series of several hundred CHROMATIC and ACHROMATIC samples, each corresponding to a certain theoretical pigment combination of FULL COLOR CONTENT, WHITE CONTENT, and BLACK CONTENT; designated by a letter-number system of notation.

Note: The most widely known collection based approximately on the OSTWALD COLOR SYSTEM is the Color Harmony Manual.

See Also: OSTWALD COLOR SYSTEM: OSTWALD NOTATION

OSTWALD HUE [5]

Designation of DOMINANT WAVELENGTH or HUE by arbitrary numbers ranging from 1 to 24.

OSTWALD NOTATION

Colors are designated by numbers and letters. The 24 Hues are numbered from 1 to 24. Each of the 36 shades are designated by 2 letters, each letter designating WHITE CONTENT and BLACK CONTENT of the shades.

OSTWALD SEMICHROME

The theoretical color which contains neither black nor white.

OSTWALD TONES

Mixtures of a SEMICHROME with black.

OSTWALD TINTS

Mixtures of a SEMICHROME with white.

OVERCAST SKY

See SKY, OVERCAST

OVERDEVELOPMENT [4]

Result of leaving film or paper in the DEVELOPER too long, resulting in excessive density and contrast. Development continued beyond the time necessary to produce normal density and contrast.

OVEREXPOSURE [4]

Excessive duration of the interval in which light is allowed to act on a sensitive surface in making either a negative, positive, or a print.

Note: Overexposure results in excessive density, a shortened tonal scale, and lack of detail. In REVERSAL COLOR FILMS it results in very desaturated, washed-out colors and detail is lost.

OVERLAP [4]

The amount by which one photograph covers the same area as covered by another, customarily expressed as a percentage. The overlap between aerial photographs in the same flight is called the end lap and the overlap between photographs in adjacent parallel flights is called the side lap.

P

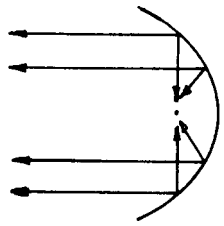
PANCHROMATIC

SENSITIZED MATERIALS with a response to all colors of the visible spectrum.

PARABOLA [4]

A parabola is the curve formed by a point in a plane so that its distance from a fixed line of the plane and its distance from a fixed point of the plane, not on the line, are equal. The importance of a parabola lies in the fact that parabolic reflectors will focus a parallel beam of light to a point and vice versa.

Note: In the Figure below is a parabolic reflector. All reflected light is focused at a point and vice versa.



PARACENTRAL VISION

Vision resulting from light falling on an area of the RETINA immediately surrounding the FOVEA.

Note: Color vision can be considered Paracentral Vision since most of the CONES are found in this zone.

PERCEPTION, COLOR

See COLOR PERCEPTION

PERIMETER

A device used in PERIMETRY consisting of a semicircular arm which can rotate about an axis perpendicular to the visual plane. Colored stimuli can be attached at the end of the arm and moved towards the center. The observer stares at the center of the arm and is asked to name the color when he first perceives it in his peripheral vision.

PERIMETRY

The mapping of the COLOR ZONES (the extent colors are perceived by the RETINA from the FOVEA outward) of the retina using a PERIMETER.

See Also: CAMPIMETRY

PERIPHERY, RETINAL

The region of the retina remote from the center of vision. Generally, the area of the retina least sensitive to colors.

pH [4]

A symbol expressing the degree of acidity or alkalinity of a solution. It is equal to the logarithm of the reciprocal of the hydrogen ion concentration

pH [4] (continued)

(LOG_{10} 1/H). A neutral solution (pure water) has a pH of 7.0 while alkaline solutions have a higher pH and acid solutions a lower pH. For example, photographic developers are alkaline and have pH's with 8-11 range.

PHOT [4]

A unit of ILLUMINANCE equal to 1 lumen/square centimeter.

Note: See Table 1 in the Appendix.

PHOTOCONDUCTIVE DETECTOR [5]

A detector of RADIANT ENERGY depending on change of its electrical resistance when irradiated.

Note: Best known photoconductive detectors are the cadimium sulfide or lead sulfide cells requiring an external source of potential.

PHOTOCHROMIC INTERVAL

The intensity interval between that at which light is just sensed and that at which it is seen as a color. During this interval light has neither HUE nor SATURATION.

PHOTOCHROMIC THRESHOLD

The light intensity threshold at which HUE is just perceived. Usually the first Hues to be perceived are those corresponding to wavelengths of 620 nm and above.

PHOTOELECTRIC COLORIMETER [5]

A photoelectric instrument using three or four photodetector-filter combinations to produce color coordinates easily transformed into approximate CIE tristimulus values.

Note: It has not yet been found possible to build a perfectly accurate photoelectric colorimeter, but there are many useful approximations.

PHOTOEMISSIVE DETECTOR

Detector of RADIANT ENERGY depending on the emission of electrons when irradiated.

Note: Photoemissive Detectors are commonly known as phototubes or photomultiplier tubes.

PHOTOMETER

An instrument used in PHOTOMETRY which measures LUMINANCE (the intensity of ILLUMINANCE). The Equality-of-Brightness Photometer employs simultaneous comparison of the sample to be measured and the standard. The Flicker Photometer presents the sample and standard to be compared, successively in the same visual area.

PHOTOMETRY

The measurement of LIGHT or the matching of brightness levels.

Note: Photometry plays an

PHOTOMETRY (Continued)

important part in SENSITOMETRY, i.e., the study of the effect of varying exposure on photographic emulsion.

See Also: SENSITOMETRY

PHOTOSENSITIVE [4]

A term used to describe substances whose chemical compositions are altered by exposure to light.

Note: The chemicals used in film emulsions are Photosensitive.

PHOTON [5]

(1) In quantum theory, the photon is the smallest unit of radiant energy.

(2) An obsolete unit of visual stimulation defined as that illumination upon the retina which results when a surface brightness of 1 candela per square meter is seen through a pupil of 1 square millimeter area.

Note: The term TROLAND is now used instead of Photon when referring to units of visual stimulation.

See Also: TROLAND

PHOTOPIC ADAPTATION

See ADAPTATION, LIGHT; LIGHT-ADAPTED EYE

PHOTOPIC CURVE

See LUMINOSITY CURVE

PHOTOPIC VISION (DAYLIGHT VISION)

Vision as it occurs when the eye is LIGHT-ADAPTED and can fully discriminate all colors.

Note: Believed to depend upon the functioning of the retinal CONES instead of the RODS alone.

See Also: LUMINOSITY CURVE

PHOTORECEPTORS (RODS; CONES)

A general term referring to both the RODS and CONES.

PHOTOVOLTAIC DETECTOR

Detector of RADIANT ENERGY generating a potential or voltage when irradiated.

Note: The most common Photovoltaic Detector is the selenium or barrier layer cell.

PHYSICAL DEVELOPMENT

The development of the latent image by deposition upon it of silver contained in the developing solution itself instead of making use, as in the more usual chemical development, of the silver already present in the emulsion.

PIGMENT

The name attached to a COLORANT when it is used in a binder such as paint.

PIGMENTED EPITHELIUM

The outer layer of the RETINA where the light sensitive ends of the RODS and CONES lie.

PINK

A very light red, reddish-orange, or reddish-purple.

PITCH [4]

(1) Air Navigation: A rotation of an aircraft about the horizontal axis normal to its longitudinal axis so as to cause a nose-up or nose-down attitude.

(2) Photogrammetry: A rotation of the camera or platform about either the Y photograph axis or the exterior Y axis; tip or longitudinal tilt. In some photogrammetric instruments and in analytical applications, the symbol phi (ϕ) may be used.

Note: Pitch causes smearing or streaking in direction of flight to occur on the image.

PLANCK'S LAW [5]

The spectral emittance (W_λ) of a blackbody can be expressed as follows:

$$W_\lambda = 2\pi c^2 h \lambda^{-5} \left(e^{hc/\lambda kT} - 1\right)^{-1}$$

where c = speed of light
h = Planck's constant
λ = wavelength
T = absolute temperature

SPECTRAL EMITTANCE of BLACKBODIES.

PLANCKIAN LOCUS

Locus of points on a CHROMATICITY DIAGRAM representing the CHROMATICITIES of blackbodies at various temperatures.

Note: See Figure 2 in the Appendix.

PLANCKIAN RADIATOR

Any radiator having the CHROMATICITY and SPECIAL POWER DISTRIBUTION of a BLACKBODY.

POINT SOURCE OF LIGHT

A theoretical source of light whose size may be defined as being that of a "point".

Note: A point source of light is a practical impossibility, but the mathematical processes of optics are greatly simplified by making calculations for light rays proceeding from a mathematical point.

POLARIZATION

The act or process of filtering light in such a way that the vibrations are restricted to a single plane.

Note: According to the wave theory, unpolarized light vibrates in all planes perpendicular to the direction of propagation. On passing

POLARIZATION (Continued)

through or contacting a polarizing medium (such as Polaroid or a Kerr cell), ordinary light becomes plane-polarized; that is, its vibrations are limited to a single plane.

POLARIZING FILTER

A filter which passes light waves vibrating in one direction only. Used over the camera lens to cut down or remove polarized rays where they may constitute objectionable reflections from glass, water, or other highly reflecting surfaces.

PLOCHERE COLOR SYSTEM

A system of SURFACE COLORS based on the mixture of known proportions of PIGMENTS.

POSITIVE

A photograph having approximately the same rendition of tones or colors as the original subject, i.e., light for light and dark for dark.

Note: A positive may be copied from an original negative or processed directly using the REVERSAL PROCESS and REVERSAL FILMS.

PRIMARY COLOR(S) (PRIMARY HUES; PRIMARIES)

(1) The colors (blue, green, and red; or violet, green, and red) from which most other colors may be produced by ADDITIVE SYNTHESIS.

(2) The colors (cyan, magenta and yellow) from which most other colors may be produced by the SUBTRACTIVE COLOR PROCESS.

Note: There is nothing absolute about primary colors. The above have been selected because more colors can be reproduced by mixing these colors than any other three colors.

See Also: PSYCHOLOGICAL PRIMARIES

PRIMARY LIGHT SOURCE

A body or object emitting light by virtue of a transformation of energy into RADIANT ENERGY within itself.

See Also: SECONDARY LIGHT SOURCE

PRIMARY LUMINOUS STANDARD [5]

A light source by which the unit of light is established and from which the values of other standards are derived.

PRINCIPAL AXIS

See OPTICAL AXIS

PRINCIPAL FOCAL POINT

See FOCAL POINT

PRINCIPAL HUES

In the terminology used in the Munsell Color System, the Principal Hues are the five hues from which the complete hue circuit is derived. They are red, yellow, green, blue, and purple.

PRINCIPAL PLANES [5]

The planes perpendicular to the optical axis in which lie the nodal points of a lens.

See Also: NODAL POINTS; NODAL PLANE

PRINCIPAL POINTS [5]

For lenses used in air, the same as the NODAL POINTS.

PRINTING DENSITIES

The densities measured to indicate the effect a negative or transparency will have when used with a particular printer and print material. These measurements must be representative of the response of the material and exposing source.

Note: For color printing the Printing Density of each dye layer should be determined for proper exposure of all layers.

PRISM

An optical solid made of glass, quartz, or other transparent material with at least two polished plane surfaces, inclined with respect to each other.

Note: Prisms are sometimes used to disperse light into bands of colors. These colors are called PRISMATIC COLORS.

PRISMATIC COLORS

A term applied to the seven simple colors (violet, indigo, blue, green, yellow, orange, and red) which result from passing a ray of white light through a prism.

PRISMATIC SPECTRUM

The spectrum of colors formed by a PRISM.

See Also: PRISMATIC COLORS

PROCESSING

The chemical treatment of exposed film to form a permanent visible image from the LATENT IMAGE.

PROTANOMALOUS VISION (PROTANOMALY; A PROTAN)

A form of the defective color vision called ANOMALOUS TRICHROMATISM in which more red is required in a mixture of red and green to match a yellow than in the case of the normal trichromat. The relative visual sensitivity is less than normal in the red, orange, and yellow regions of the spectrum. Hue discrimination is poor in the red to green region of the spectrum.

PROTANOMALOUS VISION (PROTANOMALY; A PROTAN) (Continued)

Note: In the population an estimated 1.0% of males and .02% of females are affected [6].

PROTANOPIA (A PROTANOPE)

A form of the defective color vision called DICHROMATISM in which the relative spectral visual sensitivity is much less than the normal in the red, orange, and yellow regions of the spectrum and in which colors can be matched by a mixture of yellow and blue stimuli. The eye is less sensitive than normal or "blind" to reds; therefore, reds and their COMPLEMENTS, blue-greens, are seen as gray. A Protanope's colors can be matched with mixtures of yellow and blue.

Note: In the population an estimated 1.0% of males and .02% of females are affected [6].

PSEUDOSCOPIC IMAGE

An image in which the normal impression of stereo relief is reversed.

PSEUDO-ISOCHROMATIC CHARTS OR PLATES

Charts for testing color deficiency comprised of colored spots or dots which yield a recognizable pattern (number, letter, irregular line) to a normal observer but yield a different or non-recognizable pattern to an abnormal observer.

Note: There are a number of color vision tests which use these plates including the American Optical Company Hardy-Rand-Rittler Pseudo-Isochromatic Plates, Ishihara, Dvorine, Bostrom, and Rabkin.

PSYCHOLOGICAL PRIMARIES

The four psychologically simple or unique hues of NORMAL color perception (blue, green, yellow, and red). The HUES are perceived as being unique in the visual spectrum: thus the red is neither bluish nor yellowish nor greenish; the yellow is neither reddish nor greenish nor bluish; etc.

PUPIL

The aperture through which light is admitted to the retina. It changes in diameter (2 to 8 millimeters) with variations in luminance.

Note: See Figure 1 in the appendix.

PUPIL, ENTRANCE

See ENTRANCE PUPIL

PUPIL, EXIT

See EXIT PUPIL

PUPILLA

See OPTIC DISC

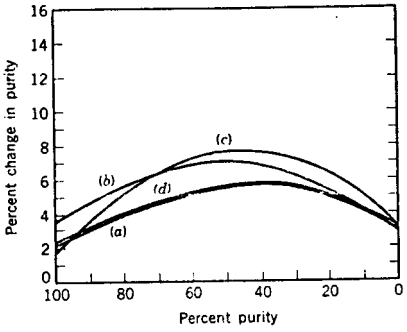
PURITY

See COLORIMETRIC PURITY; EXCITATION PURITY

PURITY DISCRIMINATION

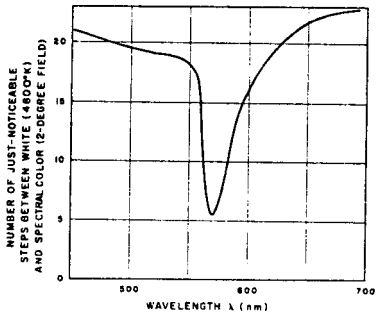
(1) The JUST NOTICEABLE DIFFERENCE in PURITY.

Note: In the Figure below is shown the JNDs in purity of wavelengths (a) 440 nm, (b) 490 nm, (c) 540 nm, and (d) 640 nm.



(2) The JUST NOTICEABLE DIFFERENCE between white and a spectral color.

Note: In the Figure below is shown the JND steps from white for the spectrum in Nanometers.



PURE COLOR [5]

Any color which, like the SPECTRUM COLORS, approaches the condition required for maximum saturation; free of added mixtures of black and white.

PURKINJE AFTER-IMAGE

See AFTER-IMAGE, PURKINJE

PURKINJE PHENOMENON (PURKINJE SHIFT)

As brightness is decreased, the blue and green wavelengths do not darken as fast as red and orange wavelengths. The phenomenon is related to the shift in retinal sensitivity during the transition from PHOTOPIC (cone) to SCOTOPIC (rod) VISION.

PURPLE

(1) A series of distinctive reddish-blue hues which are caused by combinations or mixtures of long (red) and short (blue) wavelengths of light and are not produced by any single wavelength.

(2) The COMPLEMENT of yellow-green (~560 nm).

(3) In the CIE COLOR SYSTEM, Purples lie in the region bounded by the straight line connecting the blue end of the spectrum with the red end and the straight lines from the achromatic point to the red and blue ends of the spectrum. See Figure 2 in the Appendix.

PURPLE BOUNDARY

In the CIE CHROMATICITY DIAGRAM it is the straight line connecting the ends of the SPECTRUM LOCUS.

Note: See Figure 2 in the Appendix.

Q

Q-FACTOR

See CALLIER QUOTIENTS

QUART

In liquid measure, equal to 2 pints or 32 fluid ounces. Metric equivalent 0.946 liters.

QUARTZ LENS

A camera lens made of quartz rather than glass. Transmits ultraviolet rays for special photography.

R

RABKIN TEST

A test for defective color vision which, in part, uses PSEUDO-ISO-CHROMATIC PLATES.

RADIANCE

The amount of RADIANT FLUX per unit SOLID ANGLE and unit projected area of surface of the light source.

RADIANCE FACTOR

The ratio of the RADIANCE of the body to that of a perfect reflecting diffuser identically irradiated.

RADIANT ENERGY [5]

Energy traveling through space in the form of ELECTROMAGNETIC WAVES of various lengths.

Note: Usually measured in units of energy such as ergs, joules, calories, or kilowatt hours.

RADIANT FLUX

The flow rate of radiant energy. It is expressed preferably in watts or in ergs per second.

RADIANT FLUX DENSITY [20]

The ratio of RADIANT FLUX at an element of surface to the area of that element.

RADIANT INTENSITY [20]

The RADIANT POWER emitted per unit SOLID ANGLE in a specified direction.

Note: The unit is The Watt/ Steradian.

RADIANT POWER

See RADIANT FLUX

RADIANT REFLECTANCE [5]

Ratio of reflected to incident RADIANT FLUX

RADIANT TRANSMITTANCE [5]

Ratio of transmitted to incident RADIANT FLUX

RADIATION [20]

Emission on transfer of energy in the form of ELECTROMAGNETIC WAVES.

RADIATOR

An emitter of radiant energy.

RADIATOR, COMPLETE; RADIATOR, FULL; RADIATOR, IDEAL

All synonyms for BLACKBODY.

RATIOMETER [5]

Any device used to test the ACTINIC equality of differently colored lights transmitted to the photographic material in making COLOR SEPARATION NEGATIVES.

RAY, EMERGENT

A ray of light leaving a medium.

RAY, INCIDENT

A ray of light falling on or striking a surface.

RAY OF LIGHT [12]

The geometrical concept of a single element of light propagating in a straight line and of infinitesimal cross section; used in analytically tracing the path of light through an optical system.

RAY TRACING

A trigonometric calculation of the path of a light ray through an optical system.

RAYS, MARGINAL

The rays of light passing through an optical system near the edge of the APERTURE.

RAYLEIGH SCATTERING

The scattering of light by particles or molecules whose size is smaller than the wavelength of the ray of light being scattered. The intensity of the scattered light is inversly proportional to the 4th power of the wavelength. Thus, short wavelengths (blue) are scattered to a greater extent than long wavelengths (red).

Note: On high-altitude color imagery the Rayleigh Scattering by the atmosphere causes imagery to have a bluish overcast. In addition, moist, humid air will scatter more than dry, arid air. Thus imagery collected over deserts suffers less from Rayleigh Scattering.

RECIPROCAL COLOR TEMPERATURE

A reciprocal of COLOR TEMPERATURE ($10^6/T$) usually expressed in MICRORECIPROCAL DEGREE (abbreviated mired, or μrd).

Note: Reciprocal color temperature provides a more uniform chromaticity scale than does color temperature itself: a given small interval in Reciprocal Color Temperature is approximately equally perceptible as a difference in CHROMATICITY, regardless of color temperature. For example a difference of 100 K at 20,000 K is about as perceptible as a difference in chromaticity as 10 K at 2000 K.

RECIPROCITY FAILURE (RECIPROCITY EFFECT) [4]

Photographic materials do not attain the same density from an exposure by a high-intensity light source acting for a short time as from an exposure by a low-intensity light source acting for a longer time, even though the product of time and intensity is the same in both cases. For example, when the intensity of the light is doubled, halving the exposure time does not result in

RECIPROCITY FAILURE (RECIPROCITY EFFECT) [4] (Continued)

exactly the same DENSITY. This is called Reciprocity Failure. It is present to some degree in all photographic materials.

RECIPROCITY LAW (BUNSEN-ROSCOE LAW)

The density obtained on an emulsion is primarily a function of EXPOSURE independent of the actual light intensity or time considered separately.

Note: This law does not hold strictly for any emulsion and some deviate considerably from the law. This deviation is called RECIPROCITY FAILURE.

RECORDING SPECTROPHOTOMETER

An instrument used to provide a graph of the SPECTRAL REFLECTANCE of opaque samples or the SPECTRAL TRANSMITTANCE of transparent samples, as a function of the wavelength.

See Also: SPECTROPHOTOMETER

RECURRENT VISION [5]

A succession of POSITIVE and NEGATIVE AFTERIMAGES or after-sensations.

See Also: AFTER-IMAGE

RED

(1) The hue attribute of visual sensations typically evoked by stimulation of the normal human eye with radiation of wavelengths approximately 630 nm.

(2) Any hue predominantly similar to that of the typical red.

(3) The COMPLEMENT of Blue-green (521 nm).

RED BLINDNESS

See Protanopia

RED-GREEN BLINDNESS

A common form of partial color-blindness or DICHROMATISM in which red and green stimuli are confused because they are seen as various saturations and brightnesses of yellow, blue, or gray.

See Also: PROTANOPIA: DEUTERANOPIA

RED-SIGHTED

See ERYTHROPSIA

REFLECTANCE

The ratio of the reflected RADIANT or LUMINOUS FLUX to the INCIDENT FLUX.

REFLECTED COLOR

Color seen as reflected from a perceived object.

REFLECTED LIGHT

Rays of INCIDENT light turned back or "rebounded" from a surface.

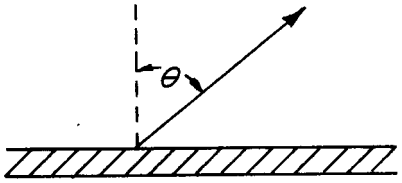
REFLECTION

Light rays being returned from a surface.

REFLECTION, ANGLE OF [4]

The angle at which a reflected ray of light leaves a surface as measured from the NORMAL.

Note: Angle θ is angle of reflection.



REFLECTION DENSITY

Defined as: $D = \log_{10}(\frac{1}{R})$
Where R is the REFLECTANCE of the sample being measured.

REFLECTIVITY

The total REFLECTANCE of a layer of material of such a thickness that there is no change of reflectance with further increase in thickness.

Note: See Figure 4 in the appendix.

REFLECTIVITY, SPECTRAL [5]

Reflectivity at a specified wavelength.

REFLECTOR

A reflector is a device which is used to redirect light by reflection in a desired direction or directions.

REFRACTING PRISM [4]

A prism that deviates a beam of light by REFRACTION. The angular deviation is a function of the wavelength of light; therefore, if the beam is composed of white light, the PRISM will spread the beam into a spectrum of colors.

See Also: PRISM COLORS

REFRACTION [12]

The bending of a light ray or the change in its direction in passing from one transparent medium into another which has a different REFRACTIVE INDEX, e.g. air into glass.

Note: Refraction occurs because the velocity of light varies according to the density of the media.

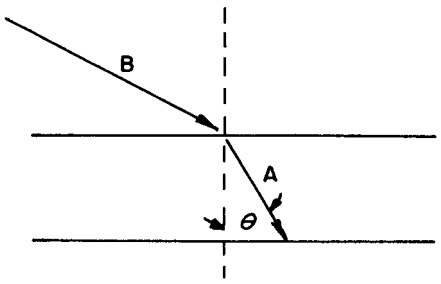
REFRACTION ANGLE [4]

The angle between the refracted ray and the normal when a ray of light passes through a transparent substance. The refracted ray is bent at an angle from the line of the

REFRACTION ANGLE [4] (Continued)

incident ray.

Note: A is the refracted ray and B is the incident ray. Angle θ is the Refraction Angle.



REFRACTIVE INDEX

(1) The ratio of the velocity of light in a vacuum to the velocity of light of a particular wavelength in any substance is called the refractive index of the substance for light of that particular wavelength.

(2) A measure of the power of a substance to refract (to bend a ray of light or change its direction) light. It is the ratio:

$$\frac{\text{sine of INCIDENCE ANGLE}}{\text{sine of REFRACTION ANGLE}}$$

when ray is incident from the air side of a glass air boundary.

Note: The greater the directional change the higher the Refractive Index, e.g. for air the index is 1.00029 and for glass, from 1.5 to 1.8.

REFRACTOR

A device, usually of prismatic glass, which redirects light in desired directions by REFRACTION.

REGISTER [5]

To cause to correspond exactly; to adjust two or more images to correspond with each other. Such correspondence may be required either in printing or in projection.

REGULAR TRANSMISSION [5]

Regular transmission is that in which the transmitted light is not diffused.

REINHOLD COLOR ATLAS

U.S. name for the METHUIN COLOR ATLAS.

RELATIVE APERTURE [4]

For a photographic lens, the ratio of the EQUIVALENT FOCAL LENGTH to the diameter of the ENTRANCE PUPIL. Expressed as f/4.5 or f:4.5; also called f-NUMBER.

RELATIVE TILT [12]

The tilt of a photograph with

RELATIVE TILT [12] (Continued)

reference to an arbitrary plane, not necessarily a horizontal plane, such as that of the preceding or subsequent photograph in a strip.

RESOLUTION [4]

(1) The minimum distance between two adjacent features, or the minimum size of a feature, which can be detected by a photographic system. For photography, this distance is usually expressed in LINE PAIRS per millimeter recorded on a particular film, under specified conditions. If expressed in size of objects or distances on the ground, the distance is termed Ground Resolution.

(2) A measure of RESOLVING POWER

Note: Color imagery may appear to have better resolution that what it, in fact, has due to the visibility of small color differences.

RESOLVING POWER

(1) Expression of the fineness of detail that can be recorded by a lens/emulsion or collection system. Usually it is stated as the maximum number of lines per millimeter that can be resolved (i.e., seen as separate lines) in the image. The resolving power of a lens, film, or their combination varies with the contrast of the TEST CHART and normally varies also with the orientation and position of the chart within the field of view.

(2) The minimum size of an image that can be resolved by the eye. It's roughly 25 to 50 seconds of arc.

RESOLVING POWER, CHROMATIC [15]

Some optical components such as prisms and gratings are used, not to resolve two or more object points but rather to separate two wavelengths of nearly equal value. The ability of an optical instrument to separate two wavelengths is called Chromatic Resolving Power and is specified as the ratio of the shorter wavelength divided by the difference between the wavelengths.

RETICULATION

A network of minute depressions or corrugations in a negative, produced -- either accidentally or intentionally - by any treatment resulting in rapid expansion and shrinkage of the swollen gelatin. Reticulation may be produced by solutions which are too warm or too alkaline or by forced drying in an air current which is too hot.

Note: The gelatin appears similar to cracked, dried mud.

RETINA

The innermost layer of the three major layers of the eyeball, upon which the visual image is focused and serves as receptor organ for vision. In the human Retina 10 layers are distinguished, and the RODS and CONES are within the second layer from the exterior.

Note: See Figure 1 in the Appendix.

RETINAL FIELD [5]

The extended mosaic of the ROD and CONE receptor elements of the retina which forms something of an anatomical correlate of the visual field.

RETINAL ILLUMINANCE [5]

The illuminance on the retina, the usual units being the TROLAND and the LUX.

RETINAL IMAGE [5]

(1) The pattern of RADIANT ENERGY on the retina corresponding to external objects.

(2) The image lying on the retina that is being viewed.

RETINAL RIVALRY

See BINOCULAR RIVALRY

RETREATING COLORS

These are generally blues and greens which tend to be perceived as leaving their picture plane or physical plane and withdrawing further from the observer.

Note: This illusion may cause exaggerated depths when viewing Retreating Colors through a stereoscope.

See Also: ADVANCING COLORS

REVERSAL FILMS, COLOR

(1) Color of the processed film is same as the original scene or is POSITIVE.

(2) Color films in which the residual silver halide is used to produce the positive dye image.

REVERSAL PROCESS

Method of developing film first as a negative silver image, and then reversing the color values to form a positive.

RIDGWAY COLOR SYSTEM

An early system of 1115 pigment colors chosen to represent by relatively equal steps a wide range of variation in HUE, SATURATION, and LIGHTNESS.

RMS (ROOT MEAN SQUARE) GRANULARITY

Approximately the standard deviation in DENSITY produced by the granular structure of an emulsion when uniformly exposed and developed as measured by a DENSITOMETER.

ROD, RETINAL

A rod-shaped structure found in the RETINA of the eye which constitutes a specific receptor for SCOTOPIC VISION.

Note: The rods in the human eye are 0.04 to 0.06 mm long and about 0.002 mm in diameter. Distinguish from retinal CONES, another visual receptor; the Rods contain the chemical Visual Purple and are believed to operate for achromatic (gray) visual qualities at low light levels, while the cones for chromatic and achromatic at higher light levels; the rods and cones form the second layer of the retina from the outside lying just within the layer of pigmented cells; it is estimated that there are 130,000 rods in the human retina; at the FOVEA CENTRALIS there are no rods, farther out they are more numerous than the cones.

ROD VISION

Sight or vision in which only RODS function; the CONES of the retina do not participate. Also called TWILIGHT VISION, SCOTOPIC VISION.

ROLL [4]

(1) Air navigation. A rotation of an aircraft about its longitudinal axis so as to cause a wing-up or wing-down attitude.

(2) Photogrammetry. A rotation of a camera or a photograph-coordinate system about either the photograph x axis or the exterior X axis. In some photogrammetric instruments and in analytical applications, the symbol omega (ω) may be used.

SAFELIGHT [4]

A lamp for use in the darkroom which supplies light of a color which will not affect the photographic material within a reasonable time. Different photographic materials require different safelight filters.

Note: Rarely recommended for fast color or panchromatic films.

SATURATION

(1) The degree to which any CHROMATIC COLOR (possessing a HUE) differs from an ACHROMATIC COLOR (gray) of the same lightness.

(2) The amount of "color" in a color sample. The more "red" in a red color the higher its saturation.

(3) The state of being saturated. A "saturated" red is a very vivid red.

SATURATION SCALE [5]

A graduated series of colors which, under appropriately controlled conditions of observation, are perceived to vary by uniform steps in SATURATION alone.

SATURATION DIFFERENCES

See PURITY DIFFERENCES

SÄTTIGUNG [5]

In the DIN COLOR SYSTEM; analogous to SATURATION.

SCALE [4]

(1) The full range of tones (grays or colors) which a photographic paper is capable of reproducing is called the "scale" of the paper.

(2) The ratio of a distance on a photograph or map to its corresponding distance on the ground. The scale of a photograph varies from point to point because of displacements caused by tilt and relief, but it is usually taken as f/H where f is the principal distance of the camera and H is the height of the camera above mean ground elevation. Scale may be expressed as a ratio, 1:24,000; a representative fraction, 1/24,000; or an equivalence, 1 in. = 2,000 ft.

SCATTERING OF LIGHT

The phenomenon of light diffusing or dividing in part into a variety of different directions in passing through a medium.

See RAYLEIGH SCATTERING; MIE SCATTERING

SCLERA

The outer protective layer of the eyeball.

Note: See Figure 1 in the Appendix.

SCOTOPIC ADAPTATION

See ADAPTATION, DARK

SCOTOPIC VISION [5]

Vision experienced by the normal eye when adapted to very low levels of illumination. The maximum of the relative spectral visual sensitivity is shifted to 510 nm and the spectrum is seen uncolored. The ROD receptors in the retina are considered to be the active elements under these conditions.

See Also: PHOTOPIC VISION

SCUM

A chemical surface layer which forms on developers, particularly pyro. Should be removed to prevent marking of negatives.

SECONDARY AXIS

A line or axis formed by the central ray of an oblique bundle of rays passing through a lens.

SECONDARY LIGHT SOURCE [5]

A body or object transmitting or reflecting light falling on it from any other PRIMARY or SECONDARY LIGHT SOURCE.

Note: The surface of a light-table is a Secondary Light Source.

SECONDARY STANDARD [5]

A secondary standard is a standard calibrated by comparison with a PRIMARY STANDARD. The use of the term may also be extended to include standards which have not been directly measured against the primary standards but derive their assigned values indirectly from the primary source.

SELECTED ORDINATE METHOD OF COLORIMETRIC CALCULATION [5]

A method of INDIRECT COLORIMETRY in which the usual numerous multiplications are avoided by summation of the SPECTRAL DISTRIBUTION data at specially selected, nonuniformly spaced wavelengths.

SELECTIVE ABSORBER

A medium which does not absorb wavelengths of light equally.

See ABSORPTION, SELECTIVE

SELECTIVE RADIATOR [5]

RADIATOR having SPECTRAL EMISSIVITY that is different for different wavelengths of the spectrum.

Note: A colored light is a Selective Radiator.

SELECTIVE SCATTERING [5]

Scattering of RADIANT ENERGY so that the ratio of scattered flux to incident flux varies with wavelength.

SELECTIVE SCATTERING [5] (Continued)

See Also: RAYLEIGH SCATTERING, MIE SCATTERING

SEMICHROME

See OSTWALD SEMICHROME

SENSATION, COLOR [5]

Primitive awareness or uninterpreted conscious response to stimulation of a visual receptor.

Note: It is very difficult and generally unnecessary to distinguish Color Sensation from COLOR PERCEPTION (which is a better term for the awareness of color in the visual field).

SENSITIZED MATERIAL [8]

General term for all types of photographic material - plates, films, and papers, etc. - that have been rendered light sensitive either by coating with an emulsion containing light sensitive silver salts or by impregnation with a chemical sensitizer.

SENSITIZING DYE

A chemical compound added to the emulsion layer to provide sensitivity to a portion of the SPECTRUM.

SENSITOMETER [8]

An instrument used in recording the response of a light sensitive material to a range of exposures. There are two types of sensitometers: one which subjects the sample of material to a series of lengthening exposures under a light of constant intensity, and the other which exposes adjacent strips of the material for the same length of time to a range of light intensities.

SENSITOMETRIC CURVE

Same as CHARACTERISTIC CURVE

SENSITOMETRIC STRIP

A strip of film exposed (generally through a STEPWEDGE) and processed under controlled conditions. Used for quality control and studying film and processing characteristics.

SENSITOMETRY [8]

The science of measuring the sensitivity of photographic characteristics, e.g., SPEED, CONTRAST, EXPOSURE LATITUDE, and FOG, D-MAX, D-MIN, time/rate (time/gamma) of photographic materials.

Note: Sensitometry seeks to establish accurately the relationship between exposure and density for any given photographic material. The chief aim of sensitometry is to derive accurate numerical values for the exposure-density relationship of a material to

SENSITOMETRY [8] (Continued)

eliminate guesswork and to state the results in units which can be universally applied and compared.

SHADE [5]

A term descriptive of a lightness difference between colors, the other attributes of color being essentially constant. A lighter shade of a color is one that has higher lightness but approximately the same hue and saturation, and a darker shade is one that has a lower lightness.

SHORT STOP HARDENER

A solution to stop the action of the DEVELOPER or color developer and to harden the gelatin.

SHOULDER (of the CHARACTERISTIC CURVE)

The high density area of the CHARACTERISTIC CURVE just above its STRAIGHT-LINE SECTION.

See Also: CHARACTERISTIC CURVE

SILVER HALIDE

A silver compound sensitive to light and used in film EMULSIONS to form a LATENT IMAGE which can be reduced to visible silver by DEVELOPMENT or removed and replaced with colored dyes.

SIMULTANEOUS COLOR CONTRAST

The unrealistic perception of a color due to the influence of a nearby or surrounding color, i.e., the juxtaposed colors (CHROMATIC or ACHROMATIC) are different than when perceived alone. How colors affect one another is very complex but, in general,:

a. A chromatic color tends to tinge the color near it with its COMPLEMENTARY COLOR.

b. The eye accentuates the difference between colors.

c. If two areas are the same color, the effect of their juxtaposition is a weakening of the intensity of their commonality.

SKY, OVERCAST

The sky when covered by haze or clouds so that the position of the sun is obscured and the illumination on the ground is even.

SKYLIGHT

The light received from the sky as opposed to sunlight.

Note: See Figure 3 in the Appendix. Note that Skylight is predominantly blue.

SLOAN COLOR-THRESHOLD TEST [6]

A diagnostic test of color vision which uses recognition of colored lights to measure degrees of red-green deficiencies

SLOAN COLOR-THRESHOLD TEST [6]

without distinguishing type. Essentially a colored light is presented below threshold, then raised in intensity until the examinee can recognize the color. Color-deficient observers may confuse amber with red, green with white, and may be unable to see red at low intensities.

SLUDGE[4]

A muddy precipitate which forms in the bottom of processing tanks or bottles after use.

SMALL AREA TRITANOPIA [6]

Isolated objects of very small angular size (about 15 minutes or less) produce either a red or green hue or some shade of gray (from white to black) when viewed directly. Green-yellow or reddish-blue distinctions may not be perceived.

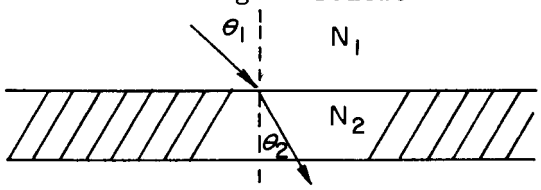
SNELL's LAW

A law which describes the behavior of a light ray as it passes from one media to another. It is:

$N_1 \sin \theta_1 = N_2 \sin \theta_2$.

N_1 = Index of refraction of incident medium
θ_1 = Incident angle
N_2 = Index of refraction of refracting medium
θ_2 = Refraction angle

Note: See Figure below.



SNOW-BLINDNESS [5]

A temporary abnormality of color vision in which all objects are tinged with red. Caused by long-continued exposure to very bright light.

See Also: ERYTHROPSIA

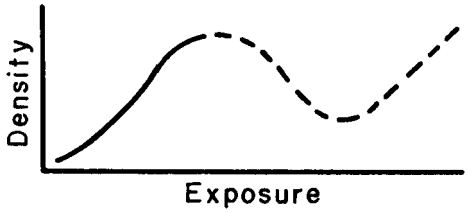
SOLAR ALTITUDE

See SUN ANGLE

SOLARIZATION [4]

A reversal of the density gradation sequence in the image after intense or long-continued exposure. A still greater exposure appears to restore the original sequence of gradation.

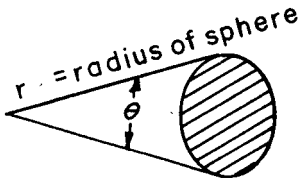
Note: The Figure below shows a CHARACTERISTIC CURVE. As exposure is increased, the density on the film eventually will decrease (dotted line); but as exposure is further increased, density will begin to increase again.



SOLID ANGLE

The angle measured by the ratio of the surface of the portion of a sphere enclosed by the conical surface forming the angle, to the square of the radius of the sphere.

Note: In the figure below, θ is the Solid Angle.



SOURCE (LIGHT SOURCE)

An object emitting radiant power.

Note: In CIE terminology, a SOURCE is distinguished from an ILLUMINANT.

See Also: ILLUMINANT

SPECTRAL ABSORBANCE

See ABSORBANCE, SPECTRAL

SPECTRAL BAND

A group of spectrum wavelengths which can vary from a small portion to almost the entire SPECTRUM.

SPECTRAL COLORS [4]

The continuous band of colors in the VISIBLE SPECTRUM which are divided into seven basic spectral colors: violet, indigo, blue, green, yellow, orange, and red.

SPECTRAL COMPOSITION

Distribution of any radiant quantity as a function of wavelength.

See Also: SPECTRAL DISTRIBUTION

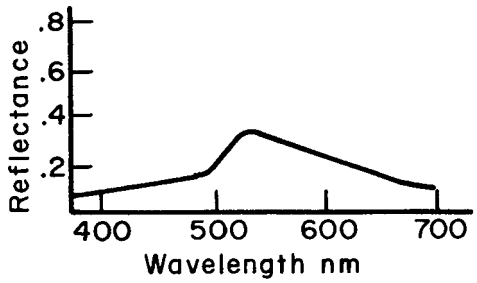
SPECTRAL CROSSTALK

See INTER-IMAGE EFFECTS

SPECTRAL DISTRIBUTION

The amounts of a radiant quantity for the various wavelengths of the SPECTRUM.

Note: In the Figure below is shown the Spectral Distribution of a green leaf. Note that the radiant quantity (Reflectance) of each wavelength is shown.



SPECTRAL EMITTANCE [20]

An emittance based on the radiant energy per unit wavelength interval.

SPECTRAL ENERGY DISTRIBUTION

The relative energy (amount of

SPECTRAL ENERGY DISTRIBUTION (Continued)

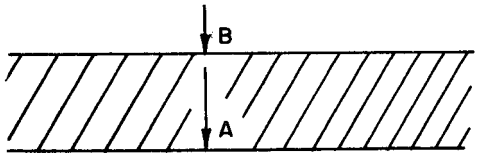
light) emitted from a source at each wavelength.

Note: The plotting of the distribution (Relative Energy vs. Wavelength) for a source is called the Spectral Energy Distribution Curve.

SPECTRAL INTERNAL TRANSMITTANCE

Ratio of the RADIANT FLUX of a narrow wavelength range leaving one face of a body to that reaching the opposite face.

Note: In Figure below it is the ratio of A to B.



SPECTRAL IRRADIANCE

See IRRADIANCE, SPECTRAL

SPECTRAL POWER DISTRIBUTION

The power (energy per unit of time) of a light source at each wavelength.

Note: The plotting of the distribution (power vs. wavelength) for a source is called the Spectral Power Distribution Curve.

SPECTRAL RADIANT ENERGY [5]

The RADIANT ENERGY per unit wavelength interval at the wavelength λ.

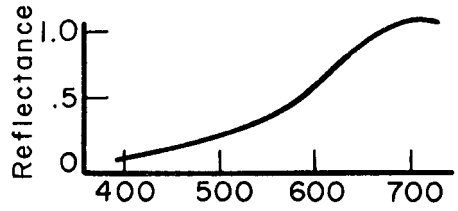
SPECTRAL RADIANT INTENSITY

The RADIANT INTENSITY per unit wavelength interval.

SPECTRAL REFLECTANCE [20]

The ratio of reflected flux to the spectrally homogeneous incident flux.

Note: The measurement of Spectral Reflectance for each wavelength is often used to plot curves of Reflectance vs. Wavelength for a particular sample. In the Figure below is a Spectral Reflectance curve for a red sample.



SPECTRAL REGION

A portion of the ELECTROMAGNETIC SPECTRUM. For example, the Visual Spectral Region is from approximately 400 to 700 nanometers.

SPECTRAL RESPONSE

The response of a light detector

SPECTRAL RESPONSE (Continued)

at each wavelength.

Note: The plotting of the response (generally 0 to 100) vs. wavelength is called the Spectral Response Curve.

SPECTRAL REFLECTIVITY

SPECTRAL REFLECTANCE of a layer of material so thick that further increase in thickness, however great, produces no change in the value of spectral reflectance.

SPECTRAL SENSITIVITY [8]

The response of a photographic emulsion (or any light-sensitive material) to each of the separate colors (or wavelengths) of the SPECTRUM.

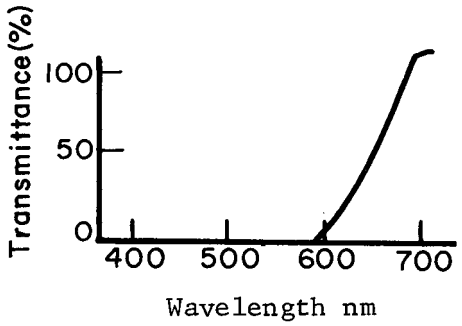
SPECTRAL TRANSMISSION (of a filter) [5]

The extent to which a filter will transmit radiant energy of different wavelengths. Shown graphically as transmission, opacity, or density plotted against wavelength.

SPECTRAL TRANSMITTANCE [5]

Ratio of transmitted to incident RADIANT FLUX of narrow wavelength range.

Note: The measurement of Spectral Transmittance for each wavelength is often used to plot curves of Transmittance vs. wavelength for a transparent sample. In the Figure below is a Spectral Transmittance curve for a red filter.



SPECTRAL VISUAL SENSITIVITY

See Spectral luminosity.

SPECTRAZONAL PHOTOGRAPHY

The imaging of narrow (or wide) bands of wavelengths by using appropriate filters over PANCHROMATIC FILM.

Note: The purpose is to amplify target/background difference by using a filter which allows only the maximum, reflected wavelengths of the target to be imaged.

See Also: MULTI-SPECTRAL PHOTOGRAPHY

SPECTROGRAM [4]

A photograph of a spectrum taken through a filter which permits the study of the absorption and transmission properties of that filter. A scale on the

SPECTROGRAM [4] (Continued)

spectrogram shows the relative amount of transmission of various colors (or wavelengths).

SPECTROGRAM, WEDGE

See WEDGE SPECTROGRAM

SPECTROGRAPH [5]

A SPECTROSCOPE in which the ocular lens is replaced by a photographic plate.

SPECTROMETER [5]

(1) A SPECTROSCOPE fitted with a divided circle for isolating or identifying wavelengths or regions of the spectrum.

(2) A SPECTROSCOPE fitted with a divided circle, used to measure index of refraction of prisms.

SPECTROSCOPE

An instrument for making a SPECTRUM visible, thereby permitting visual or photographic (making SPECTROGRAMS) examinations. Usually, consisting of a slit, a COLLIMATOR, a dispersing element (usually a PRISM), and a second lens.

SPECTROPHOTOMETER [5]

A combination MONOCHROMATOR and PHOTOMETER used to measure SPECTRAL EMITTANCE, SPECTRAL TRANSMITTANCE, or SPECTRAL REFLECTANCE.

SPECTROPHOTOMETRY

The measurement (using a SPECTROPHOTOMETER) of the absolute or relative energy within narrow bands of wavelength frequencies in the SPECTRUM. Generally presented in graphs where the abscissa represents the wavelengths of the visible spectrum (~400 to ~700 nanometers) and the ordinate represents the relative energy or absolute energy (units depending on type of measurement).

SPECTRUM (VISIBLE SPECTRUM)

The band of colors or visible wavelengths resulting from white light being passed through a PRISM or other refraction mode. The resulting wavelengths or spectrum ranges from about 400 to 700 nanometers and the colors are VIOLET, INDIGO, BLUE, BLUE-GREEN, GREEN, YELLOW-GREEN YELLOW, ORANGE, and RED.

SPECTRUM COLORS

Each wavelength of the SPECTRUM is a Spectrum Color, but they are usually grouped and called: VIOLET, INDIGO, BLUE, BLUE-GREEN, GREEN, YELLOW-GREEN, YELLOW, ORANGE, and RED.

SPECTRUM LIGHT

RADIANT ENERGY of light of one frequency or one wavelength.

SPECTRUM LINE [5]

Any one of the narrow lines, each representing light of a definite wavelength, which are observed on SPECTROGRAMS. Certain groups of lines being characteristic of specific chemical elements.

SPECTRUM LOCUS [5]

The locus of points representing the colors of the visible SPECTRUM on a CHROMATICITY DIAGRAM is the Spectrum Locus.

Note: See Figure 2 in the Appendix.

SPECULAR [4]

In SENSITOMETRY applied to a measurement made by collimated or essentially parallel light rays; referring to reflection or transmission without scattering or diffusion.

SPECULAR DENSITY

The DENSITY measured by a densitometer when the incident light on the sample is highly COLLIMATED and the collection angle is small.

SPECULAR REFLECTION [12]

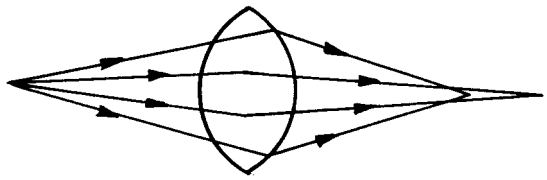
The type of reflection characteristic of a highly polished plane surface from which all rays are reflected at an angle equal to the angle of INCIDENCE.

Note: Such as the reflection from a mirror.

SPHERICAL ABERRATION [4]

An aberration resulting in light rays passing through various zones of a lens coming to focus at different places along the OPTICAL AXIS.

Note: In the Figure below is an example, where rays of light passing at the edge of the lens are focused closer to the lens than rays passing near its center.



SPHERICAL CANDLEPOWER [5]

The average candlepower of a lamp in all directions in space. It is equal to the total LUMINOUS FLUX of the lamp in lumens divided by 4 π.

SPREADING EFFECTS (ASSIMILATION)

The unrealistic perception of a color because the color of its surround spreads onto it. A red object may appear darker if surrounded by black than if surrounded by white.

SPREADING EFFECTS (ASSIMILATION) (Continued)

See Also: SIMULTANEOUS COLOR CONTRAST

STANDARD [12]

An exact value (a physical entity or an abstract concept) established and defined by authority, custom, or common consent to serve as a reference, model, or rule in measuring quantities or qualities, establishing practices or procedures, or evaluating results. A fixed quantity of quality.

STANDARD ILLUMINANT [5]

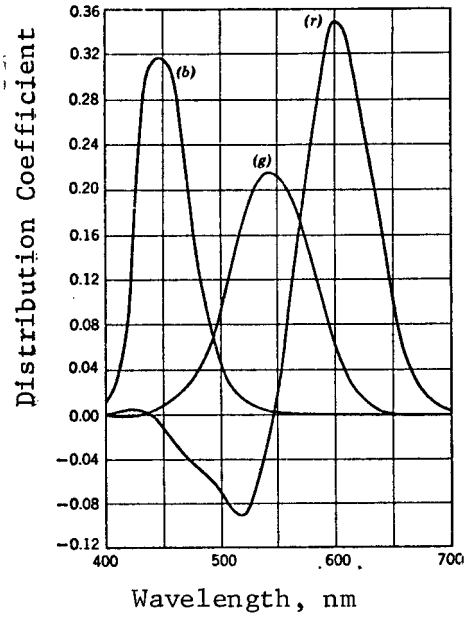
An agreed upon light source (real or hypothetical) defined by its SPECTRAL POWER DISTRIBUTION.

See Also: CIE SOURCES

STANDARD OBSERVER

The hypothetical observer possessing the characteristics of color vision as adopted by the CIE. These characteristics of color vision are defined by the CHROMATICITY CO-ORDINATES of the equal-energy spectrum with reference to a specified set of primary colors.

Note: In the Figure below are shown the characteristics of the CIE 1931 2° Standard Observer.



STANDARD OBSERVER, SUPPLEMENTARY

See SUPPLEMENTARY STANDARD OBSERVER

STANDARD SOURCE

An object emitting radiant power with an agreed upon spectral distribution.

See Also: CIE SOURCES

STEP WEDGE (OPTICAL WEDGE) [4]

A strip of film or a glass plate whose transparency diminishes and density increases in graduated steps from one end to the other; often used to determine the density of a photograph or a COLOR SEPARATION NEGATIVE.

STEP WEDGE (OPTICAL WEDGE) [4] (Continued)

See Also: NEUTRAL DENSITY WEDGE; OPTICAL WEDGE; WEDGE; STEP TABLET

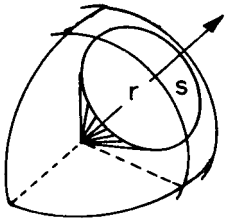
STEP TABLET (STEP TABLE)

A STEP WEDGE made either photographically (often called Silver Step Tablet) or by dispersing carbon particles in gelatin (Called Carbon Step Tablet).

STERADIAN

The measure of the SOLID ANGLE subtended at the center of a sphere when an area on its surface is numerically equal to the square of the radius.

Note: In the Figure below the size of the SOLID ANGLE is 1 Steradian.



$S/r^2 = 1 =$ one steradian

STEREOSCOPIC VISION

The particular use of binocular vision to view objects or areas to obtain the mental impression of a three-dimensional view. Usually two different perspectives of an object or area are needed, e.g., two photographs acquired at different angles.

Note: The stereoscopic vision of color imagery may be met with problems not encountered with black and white.

a. The colors on the image pairs may be slightly different, thus resulting in a fused image of a false color or BINOCULAR RIVALRY.

b. See ADVANCING COLORS; RECEDING COLORS

c. See CHROMASTEROPSIS

STILB

A unit of luminance equal to 1 candela per square centimeter.

Note: See Table 1 in the Appendix.

STILES-CRAWFORD EFFECT

The light entering the PUPIL of the eye near its edge is less effective in producing brightness than the light entering the center of the pupil. Because of this, the effective area of the pupil is smaller than the actual area.

See Also: EFFECTIVE APERTURE

STOP-BATH [11]

An acid bath into which films or prints are placed after development to check any further

STOP-BATH [11] (Continued)

developing action and to prevent stains.

See Also: HARDENING STOP-BATH

STRAIGHT LINE (of the CHARACTERISTIC CURVE)

The linear portion of the CHARACTERISTIC CURVE.

STRONG COLOR [5]

A color of high SATURATION.

SUBTRACTIVE COLOR PROCESS (SUBTRACTIVE SYNTHESIS) [11]

A method of creating essentially all the colors by using cyan, magenta, and yellow filters to subtract from white light the undesired colors. The subtractive color primaries are complementary to the additive primaries (red, green, and blue) selected so that they absorb only one-third of the luminous energy of a white light source. Thus, white minus CYAN = red; white minus MAGENTA = green; and white minus YELLOW = blue. In this way, by a suitable mixture of the three subtractive primaries, most colors can be produced by the subtractive method using only one white light source.

Note: Color Positive films use the Subtractive Color Process by layering CYAN, MAGENTA, and YELLOW DYES.

SUBSTRACTIVE COLOR PRIMARIES

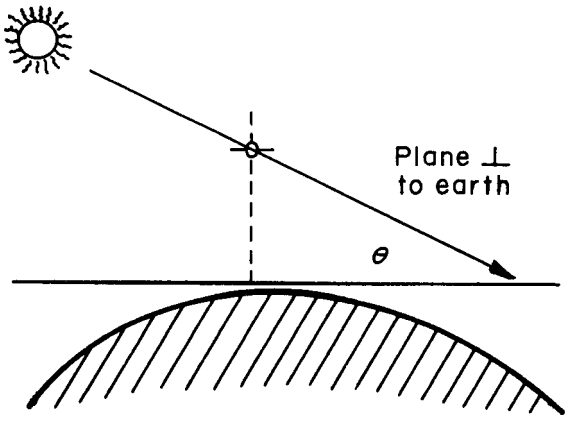
The three primaries are:

CYAN (BLUE + GREEN),
MAGENTA (BLUE + RED), and
YELLOW (GREEN + RED).

SUN ANGLE

Angle formed by an imaginary line projected from the sun passing through the collection platform and a plane tangent to the earth and perpendicular to the normal of the platform.

Note: In the Figure below Θ is the Sun Angle.



SUNLIGHT

The light emitted from the sun.

See Figure 3 in the Appendix.

SUNSPOT GLARE [4]

A "hot spot", a bright area on an image lacking in detail and color often present in high-altitude photography if steps are not taken to avoid the phenomena by using Solar Altitude Nomographs and Sun-Spot Templates.

SUNRISE AND SUNSET [8]

Light at sunrise and sunset is richer in red and orange rays than in the middle of the day. Thus, imagery acquired at high altitude close to sunrise or sunset may have a reddish or pinkish overcast.

SUPERIOR COLLICULUS

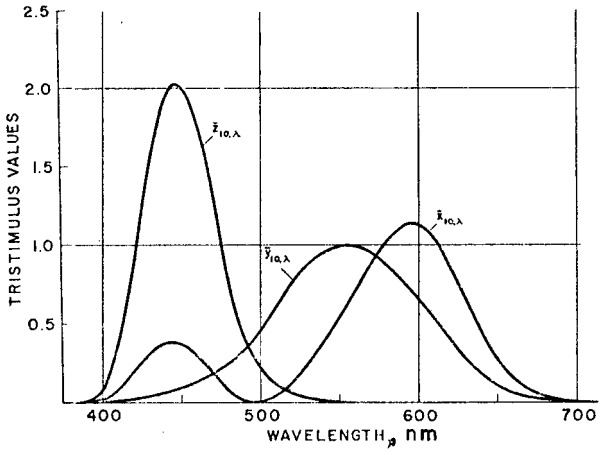
A tissue body in the brain in which some OPTIC TRACT fibers terminate. Here connections are made with crainial nerves III, IV, and VI serving reflex eye movements.

SUPPLEMENTARY STANDARD OBSERVER

A second STANDARD OBSERVER defined in 1964 by the CIE to correspond to the average human perception of large (10° on the retina or more) colored areas, in contrast to the small (2°) areas used to define the 1931 CIE Standard Observer.

Note: For the SUPPLEMENTARY STANDARD OBSERVER, the function $\bar{y}_{10}$ is not the PHOTOPIC

LUMINOSITY CURVE. See Figure below:



See Also: STANDARD OBSERVER

SURFACE-COLOR [5]

Color seen as belonging to a surface or simply the color of an illuminated surface.

SYNAPSES

Nerve junctions.

SYNCHRONOUS FILM SPEED [4]

Movement of the photographic film in a camera at the same rate of speed and in the same direction as the movement of the image during exposure for the purpose of eliminating image motion.

T

TEMPERATE COLORS

Green and red-purple, the colors that are between the WARM and COOL colors.

TEMPERATURE, ABSOLUTE

See ABSOLUTE TEMPERATURE

TEMPERATURE, COLOR

See COLOR TEMPERATURE

TEST CHART

Any chart used to test an acquisition system, e.g., using a set of LINE PAIRS for testing resolution or colors for testing color fidelity and balance.

TEST STRIP [4]

A strip of sensitized paper used as a preliminary test for exposure time in contact printing or enlarging before exposing a full sheet.

TETARTANOPIA [5]

Form of DICHROMATISM in which blue and yellow colors are confused and perceived as neutral. The existence of this form is disputed.

TEXTURE

A visual quality of the surface of objects, generally ranging from smooth to rough and shiny to dull. These dimensions affect the perception of colors; two identical reds may appear different if one is on a smooth, shiny surface and the other on a rough, dull surface. Thus, color matching should be done with the colors having the same surface texture.

THERMAL RADIATION

Radiation by solids heated to INCANDESENCE.

THOULESS RATIO

Same as BRUNSWIK RATIO except log luminances are used and thus:

$$\frac{\log S - \log S'}{\log L - \log S'}$$

See Brunswik Ratio for explanation.

Note: Thouless Ratio is preferred over Brunswik Ratio.

THREE-COLOR MIXTURE [5]

It is usually possible to match a color with a mixture of suitable amounts of light of three selected colors.

Note: The colors used for the mixture are commonly termed PRIMARIES and are usually red, green, and blue.

See Also: NEGATIVE COMPONENT IN COLOR MIXTURE

THREE-COLOR PROCESS [5]

Any process, either ADDITIVE or SUBTRACTIVE, for producing color photographs by the use of three PRIMARY COLORS.

THRESHOLD

A statistically determined point or region along some dimension where sensory judgments occur regarding the first-perceptibility or smallest perceived differences of stimuli (e.g., colors).

See Also: DIFFERENCE LIMEN

THRESHOLD, COLOR

See COLOR THRESHOLD

TIME-GAMMA CURVE [4]

A curve which indicates the change in GAMMA obtained by changes in time of DEVELOPMENT.

TIME-TEMPERATURE CHART [4]

A chart which indicates the development times necessary at various development temperatures to produce approximately the same degree of contrast.

TINT

(1) A very light, desaturated color.

(2) To lightly color.

TINTING [5]

Coloring film by dyeing the gelatin of the emulsion.

TINTOMETER

See LOVIBOND COLOR SYSTEM

TOE [4]

The portion of the characteristic curve below the STRAIGHT-LINE SECTION of the curve that represents the area of minimum useful exposure.

TONE

The overall perceptual effect of a color or a colored photograph.

Note: For example, "The image has a yellowish tone, a dark tone, etc."

TONING [5]

Coloring a film by chemical action on the silver image.

TOTAL COLOR BLINDNESS [5]

See MONOCHROMATISM

TRACK

The actual path of a collection platform over the surface of the earth.

TRANSFORMATION, COLOR COORDINATES

See COLOR COORDINATE TRANSFORMATION

TRANSFORMATION OF COLOR-MIXTURE DATA [5]

COLOR-MIXTURE DATA for one set of PRIMARIES can be used to

TRANSFORMATION OF COLOR-MIXTURE DATA [5] (Continued)

compute the color-mixture data for any other set of primaries, for the same observer. Such computations are known as Transformations of Color-Mixture Data.

TRANSLUCENT [4]

A substance is translucent if it allows light to pass through it but interferes enough with the passage of light to diffuse it to a large degree. Ground and opal glass, and thin paper are Translucent.

TRANSMISSION [4]

The amount of radiant energy of different wavelengths which a filter, lens, or film will transmit. Also called SPECTRAL TRANSMISSION.

TRANSMISSION EFFICIENCY

A measure (0 to 100 percent) of the ability of a medium to transmit light. Low efficiency means that light is lost by absorption and reflection. High efficiency, e.g. 90-100 percent, means that most of the light is transmitted.

TRANSMISSION LOSS

The loss of light during transmission through a medium.

TRANSMISSIVITY

The INTERNAL TRANSMITTANCE for a unit thickness of a transmitting material.

See Also: TRANSMITTANCE, INTERNAL

TRANSMITTANCE

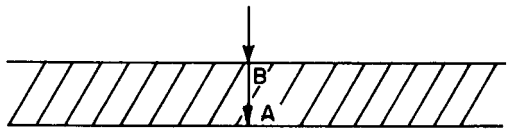
The ratio of the transmitted RADIANT or LUMINOUS FLUX to the INCIDENT FLUX.

Note: Simply the ratio of the amount of light coming out of a medium to the amount entering it.

TRANSMITTANCE, INTERNAL

The ratio of light reaching the the second surface of a medium to the light that has just passed through the first surface.

Note: in the Figure below, the ratio of A to B.



TRANSMITTANCE, SPECTRAL

See SPECTRAL TRANSMITTANCE

TRANSMITTED FLUX

RADIANT FLUX that has passed through a medium.

TRANSPARENT [4]

A term describing any substance which allows passage of light without scattering; the opposite of opaque.

TRANSPARENCY

(1) An image upon glass or film, intended to be viewed by transmitted light.

(2) A measure of the sample's ability to transmit light without scattering or diffusion or degradation of its image forming properties.

TRANSPARENCY RATIO [5]

The transparency ratio is the ratio of the parallel transmittance to the total transmittance of the sample.

TRICHROMAT

One who possesses TRICHROMATIC VISION.

TRICHROMATIC COEFFICIENTS

See CHROMATICITY COORDINATES

TRICHROMATIC COLORIMETER

A COLORIMETER which uses mixtures of three colors (usually red, blue, and green) to match a given sample.

TRICHROMATIC THEORY [5]

A color theory based on the facts of trichromatic mixture, namely that all hues may be derived from the mixture of two or more of the three PRIMARIES (usually red, blue, and green).

TRICHROMATIC INKS

The three inks used in making a three-color print. They normally correspond in color with the SUBTRACTIVE PRIMARIES (CYAN, MAGENTA, and YELLOW) but are usually called blue, red, and yellow.

TRICHROMATIC VISION

Same as Trichromatism.

THRICHROMATISM

A form of color vision yielding colors which require, in general, mixtures of three PRIMARIES (such as red, green, and blue) for their duplication. Normal color vision (NORMAL TRICHROMAT) or ANOMALOUS TRICHROMATISM are considered this form of vision.

TRICOLOR FILTER

A composite filter containing areas of three PRIMARY colors.

TRIPACK

Any film consisting of three sensitive layers in the EMULSION.

TRIRECEPTOR THEORY

A type of theory which assumes that color vision depends upon the operation of three kinds of

TRIRECEPTOR THEORY (Continued)

retinal receptors. Usually they are CONES, each of which responds to a different color, e.g. red, blue, and green. All colors are perceived because of the interaction of the three receptors.

See Also: YOUNG-HELMHOLTZ COLOR VISION THEORY

TRISTIMULUS COLORIMETER

A COLORMETER using three or four broad-band filters to provide measurements corresponding roughly to the blue, green, and red regions of the spectrum and (for most instruments) are convertible by simple calculation to approximate CIE TRISTIMULUS VALUES X, Y, and Z.

TRISTIMULUS VALUES

(1) See COLOR-MIXTURE DATA.

(2) In the CIE COLOR SYSTEM, X, Y, and Z are known as the Tristimulus Values. Each is found by integrating the area under the curve resulting from the point by point multiplication of the results of the SPECTRAL POWER DISTRIBUTION curve of the illuminant, times the SPECTRAL TRANSMITTANCE or REFLECTANCE curve of the color, times the appropriate (x, y, or z) COLOR MATCHING FUNCTION of the STANDARD OBSERVER.

TRITANOMALOUS VISION (TRITANOMALY; a TRITAN)

A form of ANOMALOUS TRICHROMATISM color deficiency which requires more blue to match a blue-green than normal. Also called blue-weak vision.

See Also: ANOMALOUS TRICHROMATISM

TRITANOPIA (a TRITANOPE)

A type of DICHROMATIC VISION in which reddish-blue and greenish-yellow colors are confused with gray and each other. Generally, blue is not perceived at all.

Note: In the population it affects approximately .002 percent of males and .001 percent of females [6].

TRITANOPIA, SMALL AREA

See SMALL AREA TRITANOPIA

TROLAND

A unit of visual stimulation defined as the illuminance on the RETINA which results when a surface luminance of 1 candela per square meter is incident through an apparent pupil of 1 square millimeter area.

Note: The name of this unit has been changed from photon to Troland to avoid the confusion caused by the subsequent physical use of photon as a name for the quantum of electromagnetic radiation.

TURBIDITY, PHOTOGRAPHIC

The spreading of edges on imagery caused by the diffusion of exposing light in the emulsion. The amount of diffusion depends on the density and size of the silver grains which reflect and retract the exposing light.

TWO-COLOR PROCESS

Any process, either ADDITIVE or SUBTRACTIVE, for producing color photographs using only two colors.

U

ULTRAVIOLET [5]

Radiant energy of wavelengths shorter than extreme violet and lying beyond the ordinarily visible spectrum. Usually assigned to wavelengths below 400 or 390 nanometers and extending to below 200 nanometers.

ULTRAVIOLET ABSORBING FILTER [4]

A haze cutting filter used mainly in photography with color films to avoid excessive bluishness and loss of contrast in the pictures; usual designations are U.V.; HAZE FILTER; Wratten 2A.

UNDERDEVELOPMENT [4]

Insufficient DEVELOPMENT, resulting in lack of density and/or contrast (desaturated, washed-out colors); caused by insufficient time in the solution, or weak developer.

UNDEREXPOSE [4]

To allow insufficient light to reach the film or printing paper for proper exposure. Underexposed color films are dark, very dense, and lack detail.

UNIFORM-CHROMATICITY-SCALE COLOR DIAGRAM

A color diagram resulting from a COLOR COORDINATE TRANSFORMATION of standard COLOR-MIXTURE DATA in which equal linear distances approximate equally perceptible steps of chromaticity.

UNIFORM-CHROMATICITY SYSTEM

A system in which pairs of colors which are perceived as being equally spaced are plotted as being equally spaced.

Note: The primary aim of this system is to transform the CIE CHROMATICITY DIAGRAM so that intervals on it are perceptually equal. On such a diagram a locus of points equidistant from a center point would be perceptually equidistant from the center point.

UNIFORM DIFFUSER [5]

A surface having a total reflection factor independent of the angle of illumination and having LUMINANCE independent of the angle of view.

UNITARY HUES

Hues perceived as not having been mixed with adjacent SPECTRAL COLORS. They are red, green, yellow, and blue.

See Also: PSYCHOLOGICAL PRIMARIES

UVEA

The CHOROID, CILIARY BODY, and IRIS form the UVEA.

V

VALUE [7]

In the MUNSELL COLOR SYSTEM it is the expression of the LUMINOUS REFLECTANCE (lightness) of an object color on a scale of 0 (Black) to 10 (white) giving approximately uniform perceptual steps under the usual conditions of observation.

Note: Munsell Value of an opaque surface may (approximately) be found by taking the cube root of the LUMINOUS REFLECTANCE according to the equation

$$V = 25\ Y^{1/3} - 17$$

where V is Value and Y is Luminous REFLECTANCE on a scale such that Y=100 for white.

VALUE LEVEL [5]

A horizontal cross section through the COLOR SOLID on which all colors are of the same VALUE or brightness.

See Also: COLOR SURFACE

VALUE SCALE [5]

A series of visually equidistant neutral grays lying between black and white.

VIEWING CONDITIONS [5]

The environmental conditions under which a visual observation is made including the size of the stimulus, characteristics of the surround, nature of the illuminant, etc.

VIGNETTING [4]

A gradual reduction in density of parts (generally at the edges and corners) of a photographic image caused by the stopping of some of the rays entering the lens. Thus, a lens mounting may interfere with the extreme oblique rays.

See Also: ANTI-VIGNETTING

VILLALOBOS COLOUR ATLAS [6]

A book of 7,279 glossy color samples, each 1 cm square with a 4-mm hole in each to facilitate comparisons. There are 38 basic colors and for each one there are 19 series of colors. Within a series each sample has approximately the same daylight LUMINOUS REFLECTANCE as the corresponding gray. There are 20 such grays from black to white. Each chip is identified by a HUE letter, a BRIGHTNESS VALUE, and a number indicating the degree or CHROMATICITY (uniform SATURATION steps for a given HUE or BRIGHTNESS VALUE).

VIOLET [5]

The hue attribute of visual sensation typically evoked by stimulation of the normal human eye with shortwave radiation around 433 nm and shorter.

VISION, CENTRAL

See VISION, FOVEAL: PARACENTRAL VISION

VISION, FOVEAL [5]

Visual sensation or perception caused by simulation of the FOVEA CENTRALIS, which is nearly 100% CONES and is thus where color perception and discrimination are optimal.

VISION, INDIRECT

See VISION, PERIPHERAL

VISION, PERIPHERAL [5]

Visual sensation or perception due to stimulation of outlying portions of the retina or non-FOVEAL VISION.

VISION, PERSISTENCE OF [5]

The tendency of visual excitation to outlast the stimulus or, more generally, the tendency of changes in visual sensory response to lag behind changes in the stimulus.

VISION, THEORY OF [5]

A systematic attempt to account for the various phenomena of visual perception in relation to the known structures and functions of the visual organs. Included by extension are the study of photoreceptors; the action of nerve-endings; related nervous structures in general, the response to light in lower organisms; the higher psychological implications of light, color, form, and their spatial and temporal relations, etc. The anatomical and physiological basis may be, to a considerable extent, hypothetical, as is the case with the current theories of color vision.

Note: See Table 2 in the Appendix.

VISUAL ACUITY

The ability of the eye to discriminate between fine differences of visual detail.

VISUAL ADAPTATION

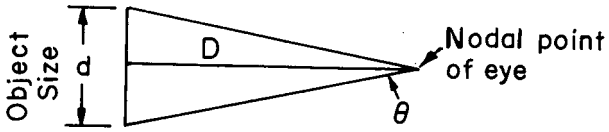
Adjustive change in visual sensitivity caused by continued visual stimulation or lack of stimulation. Three recognized types are (1) SCOTOPIC or DARK ADAPTATION, (2) PHOTOPIC or LIGHT ADAPTATION, and (3) CHROMATIC or COLOR ADAPTATION.

VISUAL ANGLE [5]

The angle subtended by any object of vision at the NODAL POINT of the eye. The magnitude of this angle determines the size of the corresponding retinal image, independent of the size or of the distance of the object alone. The nodal point is about 7 mm behind the corneal surface and about 17 mm in front of the retina.

VISUAL ANGLE [5] (Continued)

Note: The visual Angle Θ is usually approximated by measuring $\frac{d}{D}$ as in the Figure below.



For the visual angle in radian, use $\Theta = \frac{57.3d}{D}$

VISUAL COLORIMETER

A COLORIMETER in which the comparison color is adjusted until it visually matches the sample color. The comparison color is changed in steps or continuous, depending on the type of colorimeter.

See Also: VISUAL TRISTIMULUS COLORIMETRY.

VISUAL DENSITY (LUMINOUS DENSITY)

The DENSITY of a medium as it appears visually to the STANDARD OBSERVER.

Note: To measure the visual density of a medium, a densitometer is used which duplicates the human PHOTOPIC CURVE (y of the CIE 1931 STANDARD OBSERVER).

VISUAL OPACITY

See VISUAL DENSITY

VISUAL SENSITIVITY [5]

The ratio of LUMINOUS FLUX to RADIANT ENERGY FLUX.

See Also: LUMINOSITY; LUMINOSITY FACTOR; LUMINOUS EFFICIENCY

VISUAL SPECTRUM

See SPECTRUM

VISUAL TRISTIMULUS COLORIMETER

A COLORIMETER in which the visual comparison field can be adjusted to produce a continuous range of colors by modification of three stimuli, usually red, blue, and green lights.

VITREOUS HUMOR [6]

A clear, viscous liquid (specific viscosity in the range of 1.8 to 2.0) which fills the rear chamber of the eye between the lens and the retina.

Note: See Figure 1 in the Appendix.

VOLUME COLOR PERCEPTION

Color perceived as belonging to a definite tridimensional space or volume.

Note: The volume mode of visual appearance has the attribute of transparency, e.g., colored gelatin or jelly.

VON KRIES COEFFICIENT LAW [6]

The color response functions ($\bar{x}$, $\bar{y}$, $\bar{z}$, of the STANDARD OBSERVER) under one set of adaptation conditions may be considered proportional to the response functions $\bar{x}'$, $\bar{y}'$, and $\bar{z}'$ under another set of adaptation conditions.

W

WARM COLOR [5]

Any color which produces in the observer a psychological reaction or impression of apparent heat is called a warm color, usually red to orange.

See Also: COOL COLORS

WATT [4]

Unit of electrical power equal to rate of work done by one ampere under an electrical potential or pressure of one volt.

WAVELENGTH

The distance between corresponding points on two successive waves, applied particularly to electromagnetic radiations. These radiations range in wavelength sizes of a mile to a fraction of a millionth-of-an-inch (X and gamma rays). Wavelengths which are visible are called LIGHT and are measured in terms of the following units (NANOMETERS is preferred):

Micrometer (μm) 1 μm = 10^{-3}mm

Nanometer (nm) 1 nm = 10^{-6}mm

Angstrom (Å) 1 Å = 10^{-7}mm

Note: Each wavelength may be thought of as a particular color.

WAVELENGTH DISTRIBUTION

See SPECTRAL DISTRIBUTION

WEAK [4]

A term used to describe a print or negative lacking density and contrast.

WEAK COLOR [5]

A color of low saturation.

WEBER-FECHNER LAW [10]

The minimum difference in light intensity which can be discriminated ΔI bears a constancy ratio to the intensity level I or $\Delta I/I = k$.

Note: This law does not hold true and thus is considered an approximation in the middle ranges of intensity level.

WEDGE (STEP WEDGE, NEUTRAL DENSITY WEDGE, OPTICAL WEDGE) [8]

In photography, a strip of material - such as glass - covered with a layer which is clear at one end and becomes more and more opaque towards the other end (density range from 0 to 5 or 6).

Note: The layer itself may be a dyed gelatin, a suspension of pigment (such as carbon black) in gelatin, or a developed silver halide emulsion. The increase in

WEDGE (STEP WEDGE, NEUTRAL DENSITY WEDGE, OPTICAL WEDGE) [8] (Cont'd)

density may be smooth and continuous or in regular sections. The latter type is known as a STEP WEDGE.

WEDGE SPECTROGRAM [8]

The record of the SPECTRAL SENSITIVITY of a sensitized material made by giving a series of differing exposures to a SPECTRUM projected on to it. In practice the exposure scale is produced by placing a neutral density wedge over the sensitized material in such a way that each step of the wedge lies across the whole projected spectrum. This ensures that the material is subjected to the full range of exposures over every color.

WEDGE SPECTROPHOTOMETER

A SPECTROPHOTOMETER which uses a WEDGE to determine density.

WHITE

(1) The ACHROMATIC COLOR produced by emitting, reflecting, or transmitting all wavelengths of the visible spectrum equally or nearly equally.

(2) The ACHROMATIC COLOR of maximum lightness.

WHITE BODY [5]

A term applied to a SECONDARY SOURCE which is nonabsorbing at all visible wavelengths.

Note: For comparison, a BLACKBODY absorbs all visible wavelengths.

WHITE CONTENT

In the OSTWALD COLOR SYSTEM it is the amount of white in any color.

WOOD'S COLOR APTITUDE TEST

A color memory test in which the examinee is required to look at a colored test pattern and then asked to choose from a set of 4 response patterns one or none producing the same colors as the test pattern.

X

x

The CHROMATICITY COORDINATE in the CIE COLOR SYSTEM for the x-axis of the CHROMATICITY DIAGRAM.

$\bar{x}$

The COLOR MATCHING FUNCTION in the CIE COLOR SYSTEM.

X

The CIE TRISTIMULUS VALUE resulting from using $\bar{x}$.

x-AXIS

The ordinate (x-axis) of the CHROMATICITY DIAGRAM.

x-VALUE

The numerical value for the x CHROMATICITY COORDINATE.

Y

y

The CHROMATICITY COORDINATE in the CIE System for the y-axis of the CHROMATICITY DIAGRAM.

$\bar{y}$

The COLOR MATCHING FUNCTION in the CIE COLOR SYSTEM; the PHOTOPIC LUMINOSITY FUNCTION if the 1931 CIE STANDARD OBSERVER is specified.

Y

The CIE TRISTIMULUS VALUE resulting from using $\bar{y}$.

y-AXIS

The abscissa (y-axis) of the CHROMATICITY DIAGRAM.

y-VALUE

The numerical value for the y CHROMATICITY COORDINATE.

YAW [4]

(1) AIR NAVIGATION: The rotation of an aircraft about its vertical axis so as to cause the aircraft's longitudinal axis to deviate from the flight line. Sometimes called CRAB.

(2) PHOTOGRAMMETRY: The rotation of a camera or a photograph coordinate system about either the photograph z axis or the exterior Z axis. In some photogrammetric instruments and in analytical applications, the symbol kappa (K) may be used.

YELLOW

(1) The hue attribute of visual sensations typically evoked by stimulation of the normal human eye with radiation of wavelengths approximately 577 nanometers.

(2) Any color manifesting a hue predominantly similar to that of the typical yellow (wavelengths 568 to 583).

(3) The COMPLEMENT of BLUE.

(4) The color resulting from the mixtures of red and green lights.

See Also: MINUS-BLUE

YELLOW DYE

The dye formed in the blue sensitive layer of an emulsion.

Note: In positive transparencies it is formed where blue wavelengths were not imaged; thus stopping the transmission of blue except where it was imaged. In negatives it is formed where blue wavelengths were imaged, thus allowing its complement (YELLOW) to be transmitted.

See Also: CYAN DYE; MAGENTA DYE

YELLOW-GREEN

(1) The hue attribute of visual sensations typically evoked by stimulation of the normal retina with radiation of wavelengths approximately 565 nm.

YELLOW-GREEN (Continued)

(2) The complement of Bluish-Purple.

YELLOW-SIGHTED [5]

Characterizing a heightened color sensitivity for yellow or a tendency to see all objects tinged with yellow.

Note: The phenomenon occurs (1) in individuals who possess a peculiar pigmentation of certain tissues of the eye, (2) in normal individuals following blue-adaptation, or (3) following the use of certain drugs.

YOUNG-HELMHOLTZ COLOR VISION THEORY

A theory which seeks to explain the phenomena of color vision on the assumption of three independent component mechanisms (or processes) in the retina or its attached nervous apparatus; these mechanisms, when separately aroused (chiefly by radiant energy of corresponding regions in the spectrum) giving rise to the colors, red, green, and blue, respectively; all other colors including yellow, purple, and white or gray being due to various combinations of the three component activities.

Note: See Table 2 in the Appendix.

Z

z

The rarely used CHROMATICITY COORDINATE for the z-axis of the CHROMATICITY DIAGRAM.

$\bar{z}$

The COLOR MATCHING FUNCTION in the CIE Color System.

Z

The CIE TRISTIMULUS VALUE resulting from using $\bar{z}$.

z-VALUE

The numerical value for the z CHROMATICITY COORDINATE.

3.0 APPENDIX

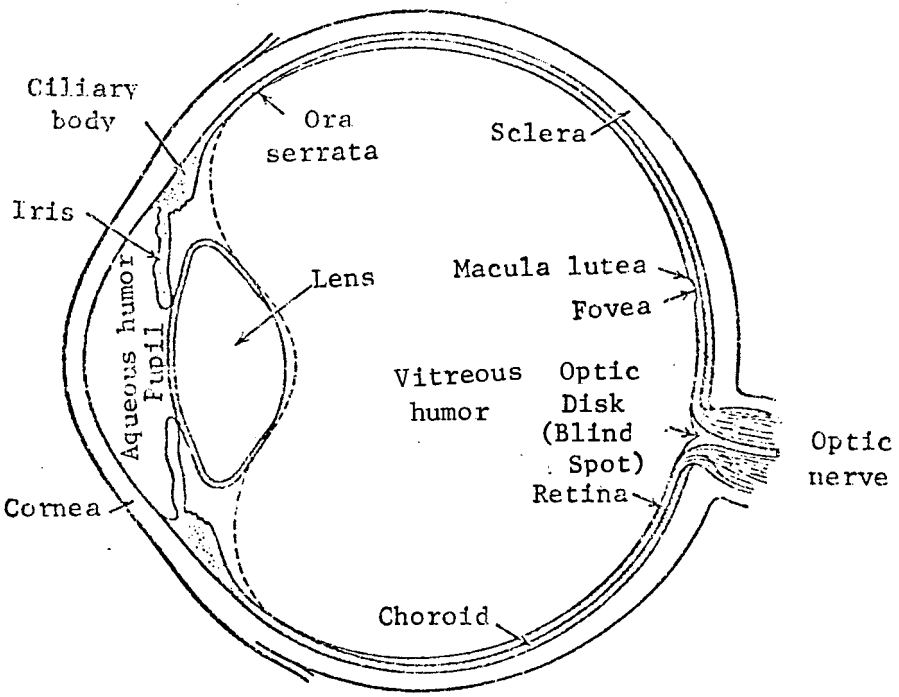


FIGURE 1. HORIZONTAL SECTION OF THE EYE

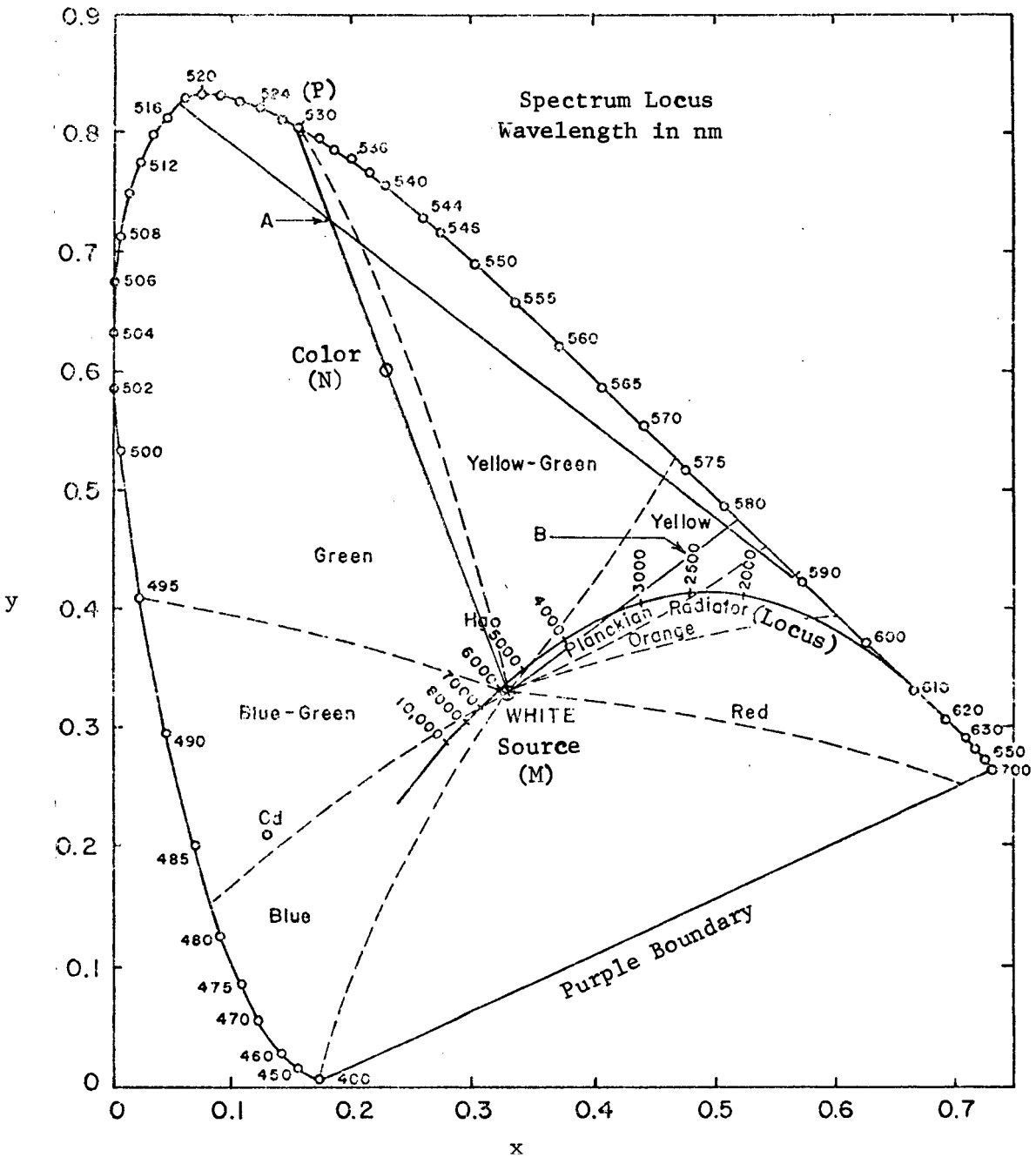


FIGURE 2. CHROMATICITY DIAGRAM

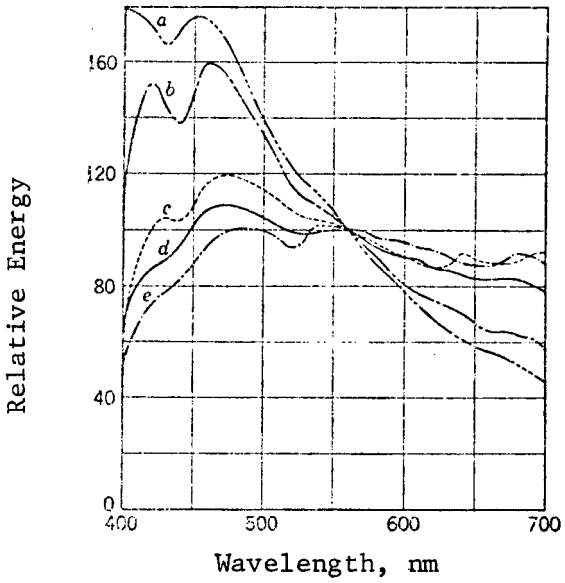


FIGURE 3. Spectral energy distribution curves of skylight from different directions and under different conditions at Cleveland, Ohio: (a) Zenith skylight, (b) North skylight, (c) Entire overcast sky, (d) Sun plus clear sky (daylight), and (e) Direct sunlight [3].

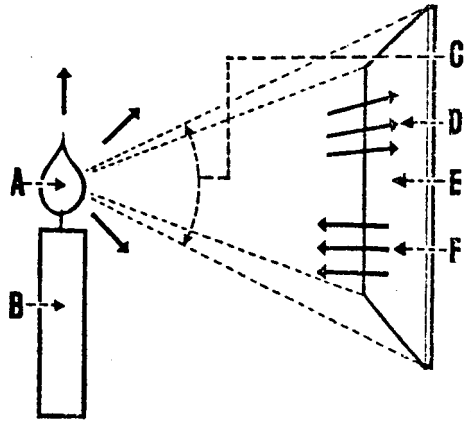


FIGURE 4. LIGHT UNITS [8]. A is LUMINOUS INTENSITY, or the amount of light emitted in all directions by a candle made to standard specifications. B is the light source of one CANDELA. C is LUMINOUS FLUX; the unit is the LUMEN. D is ILLUMINANCE or the luminous flux per unit area and is measured in LUX (lumens per square meter). E is REFLECTIVITY or the proportion of the incident light reflected by a surface. F is LUMINANCE or intensity of light reflected by a surface, measured in candela/square meter.

TABLE 1. CONVERSION TABLE

Quantity	Multiply number of	By	To obtain number of
Luminous flux	light-watts	680	lumens
	youngs	680	
Illuminance	lumens/square meter	1	
	lumens/square centimeter	10^4	lux (lumen/meter^2, lm/m^2)
	phot	10^4	
	lumens/square foot	10.76	
	foot-candles	10.76	
Luminance	stilb	10^4	
	foot lambert	3.426	
	lambert	$3.183E-10^3$	candelas/meter^2 (cd/m^2)
	candle/ft^2	10.76	
	meterlambert (apostilb)	$1/\Pi$	
	centimeterlambert	$1/\Pi E+04$	

TABLE 2. SUMMARY OF THE BETTER KNOWN COLOR VISION THEORIES [6]

Name	Anatomical Location	Fundamental Colors	Relation to CIE Standard Observer	Chief Limitation
Young, three components	Cone pigments	Red Green Violet	$+3.1956X + 2.4478Y - 0.6434Z$ $-2.5455X + 7.0492Y + 0.4963Z$ $+ 5.0000Z$	Fails to explain dichromatic vision as intended.
Helmholtz, three components	Cone response	Red Green Violet	$+0.070X + 0.945Y - 0.015Z$ $-0.460X + 1.359Y + 0.101Z$ $+ 1.000Z$	Fails to explain color perceptions of protanopes and deuteranopes.
Dominator-modulator, late König	Cone response	Red Green Violet	$+ 1.000Y$ $-0.460X + 1.359Y + 0.101Z$ $+ 1.000Z$	Fails to explain color perceptions of protanopes and deuteranopes.
Ladd-Franklin, three components, early König	Cone response	Red Green Blue	$+3.7656X + 1.4635Y - 0.2291Z$ $-1.3973X + 6.1289Y + 0.2683Z$ $+ 5.0000Z$	Implies that the blue function has a negative luminosity for normals and deuteranopes, positive for protanopes.
Hering, opponent colors	Optic nerve	Red-green Yellow-blue White-black	$+1.000X - 1.000Y$ $+ 0.400Y - 0.400Z$ $+ 1.000Y$	Fails to give an account of protanopia and tritanopia.
Von Kries-Schrödinger, zone or stage	Cone response	Red Green Blue	$+3.7656X + 1.4635Y - 0.2291Z$ $-1.3973X + 6.1289Y + 0.2683Z$ $+ 5.0000Z$	Implies that the blue function has a negative luminosity for normals and deuteranopes, positive for protanopes, fails to give an account of tritanopia.
	Optic nerve	Green-red Blue-yellow White-black	$-3.537X + 3.196Y + 0.341Z$ $+1.341X - 5.884Y + 4.542Z$ $+ 1.000Y$	
Hurvich-Jameson, quantification of Hering opponent colors	Receptor response	α β γ	$+ 6.5333Y + 0.1333Z$ $-0.3333X + 7.0000Y$ $+0.3333X + 6.4667Y - 0.1333Z$	Requires frequency-shift of photosensitive spectral distribution functions to account for protanopia and tritanopia.
	Neural response *	Red-green	$k_2[1.0000X - 1.0000Y]$	
		Yellow-blue	$k_1[0.4000Y - 0.4000Z]$	
		White-black	$(k_3 - k_4)[20.0000Y]$	
Adams, zone or stage	Cone pigments	Red Green Violet	$+3.1956X + 2.4478Y - 0.6434Z$ $-2.5455X + 7.0492Y + 0.4963Z$ $+ 5.0000Z$	Explanations of protanopia and tritanopia based on subsidiary assumptions.
	Cone response *	Red Green Blue	$+1.000X$ $+ 1.000Y$ $+ 1.000Z$	
	Optic nerve *	Red-green Blue-yellow White-black	$+1.000X - 1.000Y$ $- 0.400Y + 0.400Z$ $+ 1.000Y$	
Müller, zone or stage	Cone pigments	Red Green Violet	$+3.1956X + 2.4478Y - 0.6434Z$ $-2.5455X + 7.0492Y + 0.4963Z$ $+ 5.0000Z$	Implausible explanation of protanopic luminosity by resort to luminosity of the *yR* cone response and luminosity-inhibiting action of the *bG* cone response, both of which disappear with the *yR-bG* cone response to produce protanopia.
	Cone response *	*yR-bG* *gY-rB* Luminosity	$+5.741X - 4.601Y - 1.140Z$ $-0.932X + 2.750Y - 1.819Z$ $+ 1.000Y$	
	Optic nerve *	Red-green Yellow-blue White-black	$+6.325X - 6.325Y$ $+ 2.004Y - 2.004Z$ $+ 1.000Y$	

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